SCIENTIFIC AMERICAN

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THE BROADWAY CABLE RAILWAY, NEW YORK.

We illustrate the subway under Broadway opposite the power house at the corner of Broadway and Houston Street. In this subway, which is over 100 feet in length along Broadway and its floor 40 feet beneath the street, are placed the great inclined sheaves which direct the cables from the driving wheels in the engine room to the vertical sheaves on the overhead beam and to the arched cableways immediately under the grip slots.

The two sheaves in the foreground carry the cable running to 36th Street and return.

The inclined sheaves in the distance carry the cable to the Battery and return.

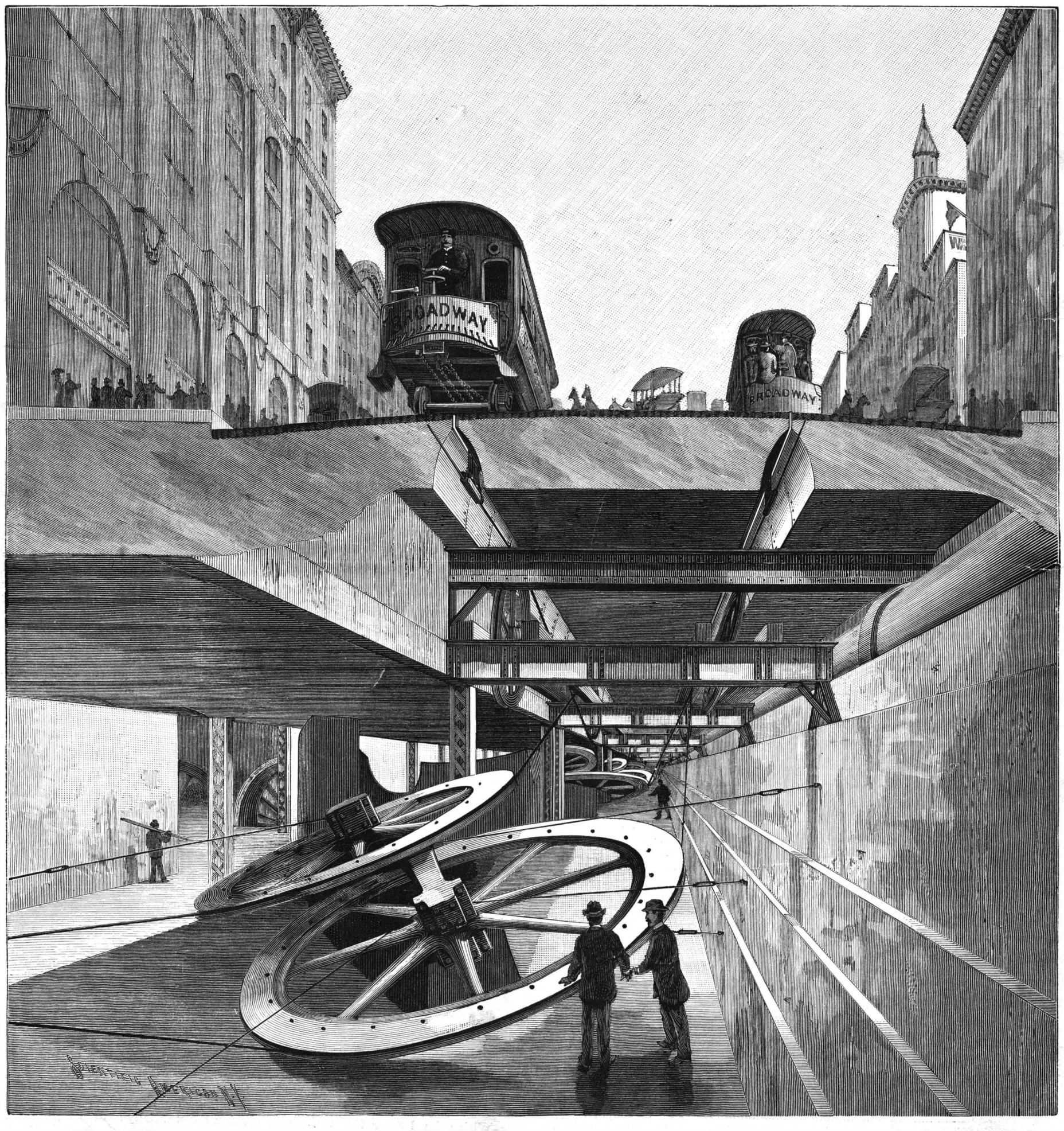
The cables between the Battery and 36th Street were started into motion on Thursday, May 11, by the seven year old daughter of John D. Crimmins, by opening the steam valve of the 2,000 horse power engine in the engine room in the basement of the great power house of the company at the Houston Street station.

The machinery and cables moved in their regular course without a hitch, and with such even regularity that the balance car on the incline moved but a few inches. A car has been run over the line from 36th Street to Houston Street, and the line to the Battery will soon be under car trial.

The drivers of the present horse cars are now being schooled in the manipulation of the grips and brakes on the uptown line, and as soon as in proper drill will be placed in charge of the downtown cars. All cars will at first be run in time with the horse cars, and the time quickened as soon as the men acquire experience in their new duties.

The illustrations of the immense steel structure of the central power house of the Broadway Cable Rail-

(*Continued on page 312.*)



THE BROADWAY CABLE RAILWAY—SUBWAY UNDER STREET OPPOSITE THE HOUSTON STREET POWER HOUSE.

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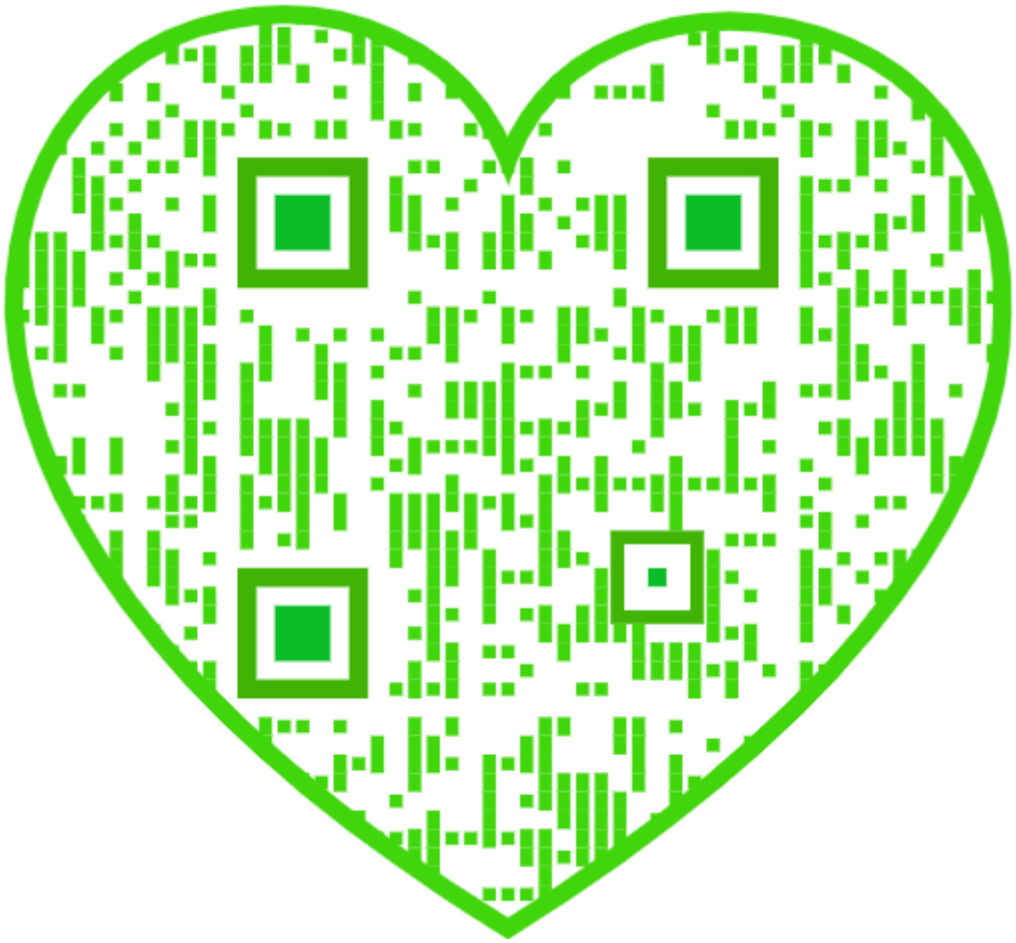

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PRICES AT THE WORLD'S COLUMBIAN EXPOSITION.

The specter of extortion is in danger of keeping many people from attending the World's Columbian Exposition, not, however, so much because of its actual presence, as because of the fear of its existence. During the first week or two that the Exposition was open there was without doubt excuse for these fears, but this is a thing of the past now. A typical case was that of three dollars a day for a room in a shack of a building, the entire furnishing of the room costing just forty-five dollars. Inside the grounds some of the restaurants charged most unreasonable prices, particularly in the cases of two foreign restaurants, which seemed to be run on the plan that Americans were gullible and would pay any price without complaint.

Investigations by representatives of the SCIENTIFIC AMERICAN lead to the conclusion that visitors at the Exposition need have no fear of excessive charges if they use judgment and discretion in securing accommodations and making other arrangements. The Exposition management has no jurisdiction whatever over the hotels, and cannot therefore regulate their prices, but fortunately there is no need of such jurisdiction, because of the intervention of the law of supply and demand. Within walking distance of the Exposition grounds are comfortable accommodations for over one hundred thousand people, while throughout other parts of the city are accommodations for two or three times as many more people, and in all parts of Chicago are plenty of honest landlords whose prices are reasonable and who can be relied upon not to resort to extortion. Intending visitors who wish accommodations secured in advance, and who have no other means of securing them, should apply to the Bureau of Public Comfort connected with the Exposition management, which was organized for the special purpose of protecting visitors from extortionists. There is no reason why visitors should fall into the hands of sharks, except their own carelessness. As with rooms, so it is with restaurants. Throughout the city are innumerable restaurants which furnish meals at reasonable rates, so that strangers with limited means can secure as comfortable living in Chicago this summer as in any other large city in the country at but little if any more cost.

As to the charges at the restaurants in the Exposition grounds, the Exposition management has required that all bills of fare and accompanying prices be submitted to a committee appointed for the purpose, and these prices are regulated in accordance with prices at restaurants of corresponding degree in the center of the city. There may be a slight increase, but this little increase visitors will willingly pay, when they appreciate the fact that one-quarter of the gross receipts of the restaurants go into the Exposition treasury toward making the great undertaking a financial success.

The cry of extortion is a false one so far as present conditions and future prospects are concerned, and should not deter one person from visiting the Exposition, which is the greatest industrial achievement in the history of the United States.

ONE HUNDRED AND TWELVE AND ONE HALF MILES PER HOUR.

Sixty years ago, when the steam engine began its competition with the stage coach as a means of passenger transit, its velocity was naturally a matter of wonder and comment. We read in the books of that period of the great speed of fifteen or even twenty miles an hour being attained by the locomotive. Under the conditions of the day such a speed was no trifle. The loosely coupled cars, with inefficient springs, rattled along over the imperfect rails and roadbed. The engine filled the air with sparks and cinders, which drifted into the cars and made life miserable for the passengers. The rails on which the cars moved were made of wooden beams, along which strips of iron were spiked. Sometimes the end of one of these strips became loosened, and bending upward over the wheel into "snake heads," would be driven through the floor of the car into the body of some unfortunate passenger, with fatal result.

The contrast between the old and the new was vividly brought out in the exhibit prepared by the New York Central Railroad for the World's Columbian Exposition. In our issue of last week we showed the two extremes of railroad engineering in the State of New York. The De Witt Clinton of 1831 stands alongside of the New York Central engine No. 999 of 1893—the pygmy beside the giant. The great dimensions of engine 999 were not all that entitled it to respect.

The engine drawing a regular train of cars on the track of the New York Central road has surpassed the speed of any object propelled by man short of a projectile. The speed of the wind in the most powerful gales has been equaled, and the flight of the swiftest bird through the air has been surpassed. The mile record for a locomotive engine on Tuesday, May 9, was reduced by it to 35 seconds. With grim humor the engineer said of the machine, she was not feeling her best, although she gave a new world's record. On May 10, between the cities of Batavia and Buffalo, a new speed test was made. Batavia was passed at a speed of sixty miles an hour. This was increased until a mile was run in thirty-five seconds, and soon after a mile was made in thirty-two seconds. For some distance a rate almost as great was maintained.

This speed, subjected to analysis, reveals the greatness of the achievement. In every second of its progress the engine covered a distance of 165 feet. This is the velocity which a body falling in a vacuum would acquire in a fall of 425 feet. In other words, if the engine could have had its course deflected to a vertical one, without loss of velocity, it would have been thrown to this height. A man at his best can run at a speed of 30 feet per second for a few seconds at a time. His best long jump is about 23 feet. With a train running at the velocity of 165 feet, it seems as if the old stories of trains jumping chasms or running over bridges too weak to support them might be realized.

There are certain landmarks set for speed achievements by our imaginations. The "even time" of ten seconds for one hundred yards has been surpassed by a running man. The bicyclist it is claimed has surpassed his "even time" of a mile in two minutes, and aided by ball bearings and pneumatic tires the trotting horse drawing a sulky is approaching the same figures. The carrier pigeon with only aerial friction to contend against approaches a speed of a mile in one minute. The running horse may yet reach the record of a mile in a minute and a half. Engine 999 has already established her goal. It is a mile in thirty seconds, and it is believed that she will soon reach it.

The achievement means a great deal. The advocates of flying machines speak of a possible speed of sixty or perhaps a hundred miles an hour. Recent experiments with direct-geared electric motors have indicated the possibility of a speed of one hundred and twenty miles an hour. Atmospheric resistance at this rate begins to be taken into account as an important factor.

Geo. Westinghouse, Jr., a recognized authority on the subject, has shown the difficulties in bringing fast trains to a stop and in reducing their speed on emergencies. His communication was reprinted in our issue of October 8, 1892. He depicts the many troubles to be encountered in running trains at the rate of ninety miles an hour. In the face of all this the great engine of the Columbian Exposition, while still new, while drawing a regular passenger train, and without any special preparation, runs at the rate of 112½ miles an hour. It is a striking instance of theory and practice brought face to face.

THE ELECTRIC RAILWAY TROLLEY.

Another broad patent for a gigantic monopoly has recently been issued by the Patent Office. This is a patent for the invention of the late Chas. J. Van Depoele, who was a well known electrician. The patent was applied for in 1887, but other inventors claimed substantially the same thing at the same time, which led to the taking of evidence from the several claimants to determine who was the original and first inventor. These proceedings, termed interference proceedings, have recently been brought to a close, and the Patent Office awards the patent to the administrator of Dr. Van Depoele, the inventor himself having passed away. The patent has been purchased by the Thomson-Houston Electric Co., and if its validity is sustained, of which there is at present no reason to doubt, the above company will enjoy a far-reaching monopoly, covering substantially all the electric railways in the country and the plants therewith connected. Over six thousand miles of these railways are now in operation and they are being extended rapidly in all directions. This monopoly has seventeen years to run. It is probably of greater importance to the public and of more value to its owners than the telephone invention.

The claims of the Van Depoele patent are very broad and comprehensive. The principal claims are as follows:

The combination of a car, an overhead conductor above the car, an upwardly extending and laterally movable arm carried by the car and having its upper end free, and a contact device carried by the arm at its free end, and making underneath contact with the conductor.

The combination of a car, an overhead conductor above the car, a contact device making underneath contact with the conductor, and an arm on the car movable on both a vertical and a transverse axis and carrying the contact device.

In an electric railway the combination of a car, a conductor suspended above the line of travel of the car, a rearwardly extending arm pivotally supported on top of the car so as to swing laterally and provided at its outer end with a contact device engaging the under side of the suspended conductor, and a tension spring for maintaining an upward pressure contact with the conductor, substantially as described.

OVER one thousand steamships are traversing the four great ocean routes.

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There was a great drop in the number of visitors at the World's Columbian Exposition grounds immediately following the opening day. The attendance during the week did not average over 35,000 paid visitors daily. In many respects this small attendance was a fortunate thing for the Exposition, as it granted exhibitors opportunity to complete the work of installing their exhibits without being interfered with by crowds of sightseers. The result was that an immense amount of work was accomplished both inside the buildings and in completing the work of laying out the grounds.

Much to the surprise of everybody who had not witnessed the progress of installing exhibits, the Government building was the first one completed. The machines shown by the War Department in this building which manufacture cartridges, and other machines shown by the government mint which manufacture souvenir coins, to demonstrate the manner in which silver and gold coins are made, attracted especial attention, not alone from the interest of the general public in these things, but from the fact that they were about the only machines which were prompt in starting with the opening of the Exposition.

Another exhibit in the Government building which has proved particularly attractive to visitors is that of the models shown by the Patent Office. This exhibit is very complete, comprising something like 3,000 models representing as nearly as possible every important line of invention. A large number of the models shown were made by the Patent Office for this exhibit, and they include many interesting historical inventions. In connection with the more important inventions many models are shown to illustrate the progress made in this particular line of invention. The exhibits are especially complete in firearms, steam engines of all kinds, agricultural implements and especially in all kinds of labor-saving devices.

The appearance of the official catalogue on the opening day of the Exposition was a surprise, especially because of its complete condition. This catalogue is of different form than such catalogues usually are, a different volume being issued for each department. This is a great convenience, because a bound volume of all the catalogues would be very bulky and approach in size a book half as large as the Chicago City Directory. Each catalogue contains considerable condensed information regarding the Exposition, its officials and other subjects, besides general information regarding the building and exhibits it directly refers to. A different scheme of installation was followed in nearly every building because of the differences in design of the buildings. In each catalogue are diagrams showing the scheme of installation of the special building to which the catalogue refers. By using this diagram a visitor can readily find just the location of any particular exhibit, as all of the exhibits have references to the particular section in which they are installed. In general it can be said of each building that the sections are arranged alphabetically one way and numerically another. If the reference following a certain exhibit should be D—4, an examination of the diagram would show exactly the relation this space bears to the building. The catalogue of the English exhibit was issued promptly and is an excellent specimen of printing. It contains a map of the grounds and buildings upon which the position of the Victoria House and the British exhibits in each building are indicated by red marks.

An unfortunate misunderstanding arose in the Department of Mechanic Arts immediately following the opening of the Exposition regarding the matter of power. The exhibitors seemed to infer that whatever power they wished was to be furnished by the Exposition without cost, while the Exposition proposed to charge $60 per horse power during the Exposition. The difficulty seemed to be chiefly because the exhibitors likened this Exposition to a county fair, which is obliged to offer all sorts of inducements to attract exhibits. The Exposition management does not consider that it is holding the Exposition for charitable purposes, but for the public benefit, and it believes that every exhibitor who makes a creditable showing will reap inestimable benefits from the display of his machines or wares. Some of the exhibitors, in their excitement, threatened to cover up their exhibits with canvas, while others proposed to withdraw their exhibits. The Exposition does not propose to permit either of these things to be done.

As has been said before in these columns, the color effects at the Exposition have been designed to be made by flags and bunting. For this purpose there are over 700 flagstaffs on the buildings and throughout the grounds that have been set up by the Exposition management. One of the most effective sights on the opening day was to see a flag thrown to the breeze from nearly every one of these staffs at the instant the Exposition was declared open. Most of the flags shown are the American colors, but the Exposition also shows its own colors, and in addition there are the special banners and emblems of forty-seven different nations. All the American flags were made in this country, while most of the foreign flags were manufactured in France. The special bunting for exterior and interior decoration was manufactured on the grounds by the Exposition management, and over 5,000 such flags have been made in stock. The flags for exterior decoration are made of material that is not only strong, but with fast colors, while the bunting for interior use is considerably cheaper material. In the larger buildings a large amount of this bunting is used; in the Manufactures and Liberal Arts building there are at least 400 sets of flags representing all the nations exhibiting. Hanging from the top of each immense truss is an American flag of immense size, which is very conspicuous among the other flags. On the exterior of this building there are 200 flagstaffs. It has been found quite impossible to make an elaborate display of the flags of each nation at all times, and they have therefore been divided into relays, as it were, by which the flags of sixteen different nations are exhibited in daily rotation.

Strict rules regarding the use of vehicles in the Exposition grounds are now in force. No wagon or vehicle of any kind is permitted on the promenades except the police and hospital patrol wagons in the employ of the Exposition. Bicycles and all other vehicles are excluded, excepting of course the wheel chairs, which are a special concession. All supplies for use in the restaurants or for other purposes are delivered during the night time, and in special cases where deliveries are to be made during the day time, they must be made in push carts wherever possible.

Advertising matter may be distributed within reasonable limits, and the Exposition has not yet drawn any close lines within which exhibitors must keep themselves. Circulars, catalogues and other literature pertaining to any specific exhibit may be freely distributed. There will be no general advertising allowed that shall in any way interfere with the best interests of both exhibitors as a class and of the visitors.

The French fine arts display in the Gallery of Fine Arts was completed and thrown open to the public on May 5. This is believed to be the finest display by all odds that the French people have ever made, though perhaps not quite so extensive as the one at their own Exposition.

There was much complaint during the first week that the Exposition was opened of extortionate prices in the restaurants. In most cases there was ground for these complaints, and so much was said about the extortion by the local press and the public in general that the Exposition management took the matter in hand and made a careful investigation, comparing the prices in all of the restaurants with prices in restaurants of corresponding degree in the heart of the city. The result is that prices in all cases have been modified when necessary, so that a visitor can now get as good a meal at the Exposition grounds as in any restaurant in Chicago, for little, if any, advance. The fact that one-quarter of the gross receipts of all the restaurants go toward defraying the expenses of the Exposition accounts for any slight increase in price.

The Intramural Railway was not ready for operation the first week and scarcely ran a train for passengers, owing to delay in completing some of the motor cars and in making connections in the steam plant. On May 8, however, everything was completed so that the trains were running regularly and many passengers were carried.

The first evening the Exposition was opened for the purpose of fully testing the electric display, which has received so much attention from the engineering department, and which has been anticipated with so much expectation by the general public, was on May 8. The attendance in the evening was large, and the results were much finer than had been anticipated, even by the engineering department. The scenes about the basin were grand beyond description. Two of the immense search lights were used. The Administration building was illuminated in the most elaborate way, both exterior and interior, while the faces of the buildings adjoining the basin were ablaze with electric lights. The display was not so elaborate as it will be a little later, because the electric fountains did not play.

The Sunday question, which has been so seriously agitated for many months past, was given a practical test on May 7, the first Sunday after the Exposition was formally opened. The Sunday-closing rule was rigidly enforced, the foreign commissioners, as well as many government and Exposition officials, were excluded from the grounds. Fully seventy-five thousand people gathered outside the gates, expecting to be admitted, as this was the first Sunday that the grounds have been closed since work was begun on the Exposition. In addition to these people there were believed to be one hundred thousand people in the city who also expected to spend the day at the grounds, but who did not go out because of the fact that the papers announced that the Exposition was closed. The results of the day were not particularly satisfactory to either side in the Sunday-closing discussion, because of the behavior of the crowds outside the gates and of t general drunkenness and lawlessness that resulted. T movement favoring an open Sunday received consi erable strength as the result of this one day's exp ment, and everything points to an open Sunday least by June first, if not before.

Phillips Flying Machine.

In the many attempts which have been mad solve the problem of aerial navigation, the princ most in favor of late years has been tha of la plane surfaces. Upon this principle for oi- s eight years past Mr. Horatio Phillips has dl.ne. at length he has succeeded in demonstrat e Pc principle is fundamentally correct. But ph duced the dimensions of his planes from ssin five feet broad to those of Venetian blind le R to his advantage. His method of proceedi e o entirely different from that hitherto pursue ica working in the same field, as neither large p faces nor balloon arrangements are employed, stored-up energy used. Advantage is taken vacuum and a plenum formed by induced vere the upper and under surfaces respectively o neri slats or laths fixed horizontally in a verti The These slats are curved on their upper and ge f faces and are thicker at their leading edg w their trailing edge. The curves are such that ess vex upper surface near the front edge deflects th upward, thus creating a partial vacuum on the surface of the slat or sustainer. The under surf the slat is formed to a parabolic curve which gradu puts the particles of air into motion downward, th producing an excess of pressure on the under surf of the slats. The principle has been put into prac by Mr. Phillips in a machine which broadly resem a canoe with a sail like a Venetian blind with the s fixed wide open, the machine being driven forward an air propeller to which motion is given by a stea engine.

The carriage is 25 feet long and 18 inches wide, t (ing to a point at the front end. It is borne on wheels a foot in diameter, one in front and two at rear. There are 50 sustainers or slats, each 1⅛ i wide and 22 feet long, fitted 2 inches apart in a 22 feet wide and 9 feet 6 inches in height. The su ers have a combined area of lifting surface of 136 s feet. The boiler is a cylindrical phosphor bronze sel 12 inches in diameter and 16 inches in length. heating surface is 12 square feet, and is made t Field tubes ¾ inch outside diameter and 14 in long. The firegrate area is 70 square inches, an fuel used is Welsh coal. The engine is compound, w ing cylinders 1¾ inch by 3⅝ inch by 6 inch st fitted with ordinary slide valves. The working p sure of steam is 180 lb. per square inch. The propel is 6 feet in diameter and 8 feet pitch, and has a p jected area of blade surface of 4 square feet. Th speed is about 400 revolutions per minute, and the est mated speed of the machine about 35 miles an hour The weights of the various parts of the machine ar approximately as follows: Carriage and wheels, 60 lb. machinery complete in working order, with water i boiler and fire on grate, 200 lb.; sustainers, 70 lb.; tot weight of machine, 330 lb.; total weight, lifted an carried, including 72 lb. of added weight, 402 lb.

In order to test the machine a wooden track 628 fee in circumference and about 6 feet wide has been l in the gun-proving grounds of Messrs. Cogswell & I rison, at Harrow, the machine being tethered to a tral post. In some trials which we recently witne a number of runs were made, with the result t speed of 28 miles an hour was attained. As regi the ascensional powers of the machine, it was sho that it had a lift of about 3 feet from the ground at rear. The rise reached its maximum when the chine ran in the face of the wind, and was continu over about two-thirds of the track. The machine w also moored by a stern rope in which a dynamome was inserted, and on the engine being run at speed, the dead pull was 75 lb. On the whole the chine is one of promise, and is certainly a step in vance in aerial navigation.—*Iron.*

Fast Time of the Campania.

The new Cunarder, the Campania, arrived out Queenstown from New York on the morning of 12, having made the voyage in 5 days, 17 hours, an minutes, thus beating by more than two hours best previous eastward record, namely, that of New York, in 5 days, 19 hours, and 57 minutes. t best day's runs of the Campania were 481, 490, 474 and 492 miles, and the total distance traversed 2,868 miles. An illustrated description of the Cam was published in SCIENTIFIC AMERICAN of Mar

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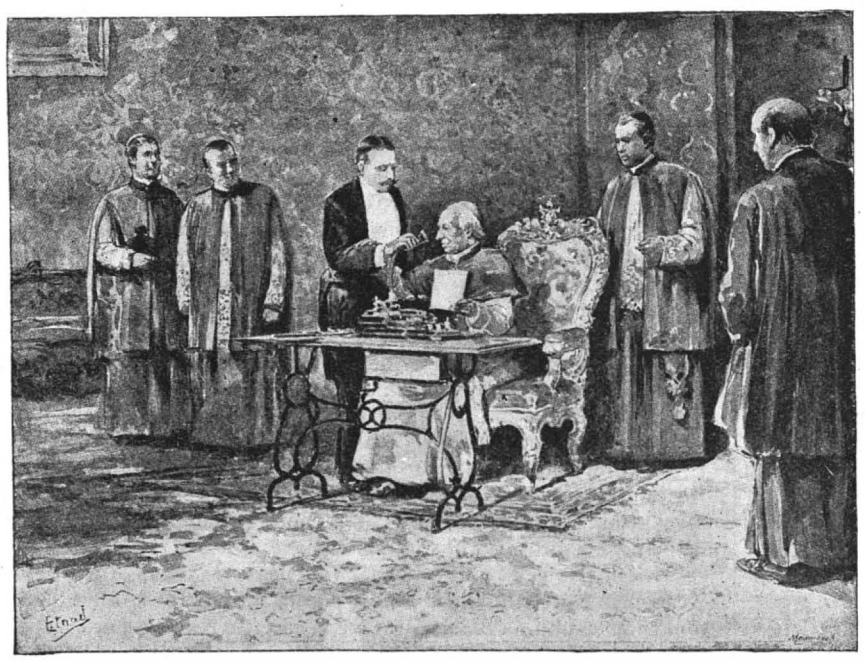
THE WORLD'S COLUMBIAN EXPOSITION—THE POPE'S PHONOGRAPHIC MESSAGE TO AMERICA.

We recently gave a description of the first trial of a phonograph by his Holiness the Pope at Rome, and we now present an engraving of the scene as given in the London *Graphic*.

The Pope gave a private audience on March 19, in his study, to Mr. Stephen Moriarty, who was introduced by Mgr. Merry del Val, the papal chamberlain. Mr. Moriarty had with him a phonograph, by means of which he delivered an address in Italian congratulating the Pope on the occasion of his episcopal jubilee. He went on to say that he felt deeply honored in being the bearer of two messages—one from the late Cardinal Manning and the other from Cardinal Gibbons, Archbishop of Baltimore, who would in their own words express their devotion to his person. He concluded by begging the Pope to speak into the phonograph some expression of love and his blessing, which might be delivered to the German Catholics of America on the occasion of the opening of the Columbian Exhibition. He pointed out that if the Pope granted his request, it would be the first time in the history of the Papacy that the voice of the reigning Pontiff had been heard in America.

The Pope then listened to the message from the late Cardinal Manning, in which his Eminence asked for a blessing and expressed a hope that the Catholic faith would soon spread over the whole world. The Pope was visibly affected when he heard the voice of the dead cardinal. He then heard the message of Cardinal Gibbons, who asked for the blessing of God upon the Pope. His Holiness promised to send a phonographic message to the United States, and invited Mr. Moriarty to return for another audience. This was given on Monday, in the Pope's private study, the members of the Papal Court being present. At the request of his Holiness, the messages of Cardinal Manning and Cardinal Gibbons were repeated on the phonograph. The members of the Papal Court were amazed at hearing the voices of the two cardinals loudly and clearly reproduced, while the Pope sat back on his throne laughing at their astonishment. The Pope then said: "I will now send my message to the people of the United States," and bending over the phonograph, he spoke into it. Then, turning to Mr. Moriarty, he said: "I hand you this message; guard it carefully, for it is the expression of my love for all the people of the United States. I wish you to deliver it with your own hand to the President." This message, which is in Latin, by the Pope's special request will not be published before it has been reproduced in America.



THE POPE'S PHONOGRAPHIC MESSAGE TO AMERICA.

THE CROSSING OF RIVERS BY MEANS OF LEATHERN BOTTLES.

The advantages that an army in campaign can obtain from the use of leathern bottles as floating supports cannot be overestimated. A leathern bottle made from an ox hide is capable of sustaining upon the surface of the water a weight exceeding that of two men, and may be easily used for the creation of rapidly manufactured rafts. Although the subject is somewhat technical, it appears to us of interest to show how it is possible to make these bottles *in situ* by means of the hides of the animals which serve for the feeding of the soldiers, and which the troops themselves daily slaughter in considerable numbers. As concerns this, the *Journal du Genie Russe* contains some detailed information that we shall analyze.

"An ox may be slaughtered in three ways. The first, and most imperfect, method consists in striking it in the forehead with a felling ax. Two men then seize the animal by the horns, throw it down and cut its throat. The second, which is less cruel and more expeditious, requires a little more skill on the part of the men who are called upon to apply it. A two-edged knife is arranged between the nape and the first vertebra and driven in with a blow of the fist, and the operation is then finished as above. The third comprises the following operations. The fore legs of the ox are first tied together, and then the hind ones. On causing the former and latter to approach each other, the animal is thrown down. Its four legs are then tied together and its throat is cut. This process is the easiest to put in practice by inexperienced men. It has the advantage over the preceding that it is applicable to horses.

After the animal has been killed, its head is cut off according to the line, C D, and an incision is made from D to J (Fig. 1). Afterward, the skin is cut from the legs below the knees and the bones are removed by a disarticulation of the knee joints. The skinning is begun at the neck. An incision is made with a knife, and the hide is turned up on one side of the paunch so as to disengage the shoulder blade, which is then detached. Next, the corresponding leg is skinned. After this the same operation is performed on the other side. Then the hide of both sides is acted upon at the same time, and the lungs, liver, stomach, spleen and intestines are removed in order to facilitate the rest of the skinning. For the posterior part of the body, one operates in the same order, first on the back and sides and then on the legs. When the tail is reached, only 12 inches of it are preserved. Care must be taken not to cut the hide. The right hand, open or closed according to the stress to be exerted, is used for separating the flesh from the hide, while the left hand acts upon the latter.

It is now a question of closing the apertures that the hide presents. To this effect, holes 2 inches in width and 3 inches apart are made around the apertures and upon the two thicknesses at once (Fig. 2). Then the skin is turned inside out and a wooden pin 5 or 6 inches in length and ¾ inch in diameter is inserted in the holes, and with five or six turns of twine, a tight ligature is made behind the pin, which holds it in place. This done, the skin is turned right side out and the tying of the neck is begun. A blunt pointed pin about 12 inches in length and 1½ inches in diameter is introduced into the holes in such a way as to perforate the two sides of the hide and bend them alternately to the right and left, and then a ligature is made with eight or ten turns of strong twine. In order to tie the legs, eight or ten turns of twine are made, but no pin is employed. Before closing the fourth leg, the hide is inflated either with a bellows or the mouth. In the latter case, a reed pipe, T (Fig. 2), is used. The raft is formed of logs and cross ties from 12 to 14 feet in length and about 3 inches in diameter, assembled with tenons, or more simply with ligatures. The bottles, to the number of from four to six, are connected by the legs, which turn up over the cross pieces and are tied thereto with twine. Fig. 3 represents a raft thus formed, carrying Russian troops. Holes are arranged for the oars, and, finally, the frame is covered with 5 inch planks for the carriage of infantry and with 14 inch ones for campaign artillery. A leathern bottle made of an ox hide weighs about 26 pounds. When it is inflated, it has a sustaining power sensibly equal to the weight of the animal from which it is derived, say about 440 pounds. A raft of four bottles is capable of supporting ten men while still preserving a projection of 6 inches above the surface of the water. With six bottles it will sustain twenty men and project from 3 to 4 inches above the surface. Among these men, there are four oarsmen, who sit at the sides.

These bottles can be used immediately after their manufacture, but a few precautions are necessary in order to preserve them for a certain length of time. In the first place, at the time of preparation, the flesh side is treated with 13 pounds of marine salt, and the hide is then dried for three or four days under a shed. After this, the same side is covered with a hot mixture of tallow and birch tar. This coating is renewed when some time is to intervene before the bottles are used. They are always preserved with the hairy side within, under well ventilated sheds, and they are inspected from time to time in order to make sure that rodents are not injuring them. During the course of practical exercises, it is well to take them out of the water every day, without discharging the air from them, and to place them upon planks under shelter from the sun. It is necessary also, every week or two, to renew the cords with which they are attached.—*La Nature.*

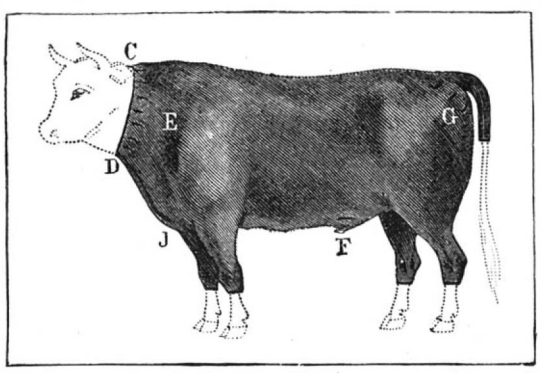


Fig. 1.—MANNER OF CUTTING THE OX.

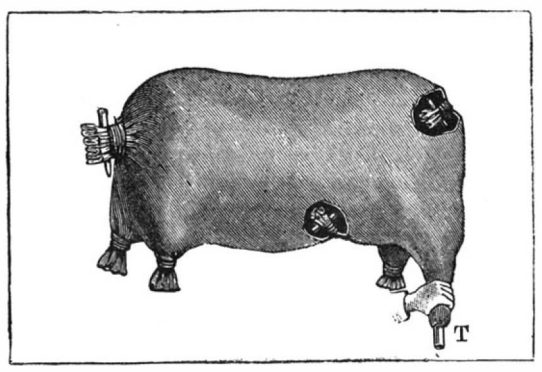


Fig. 2.—MANUFACTURE OF THE LEATHERN BOTTLE.

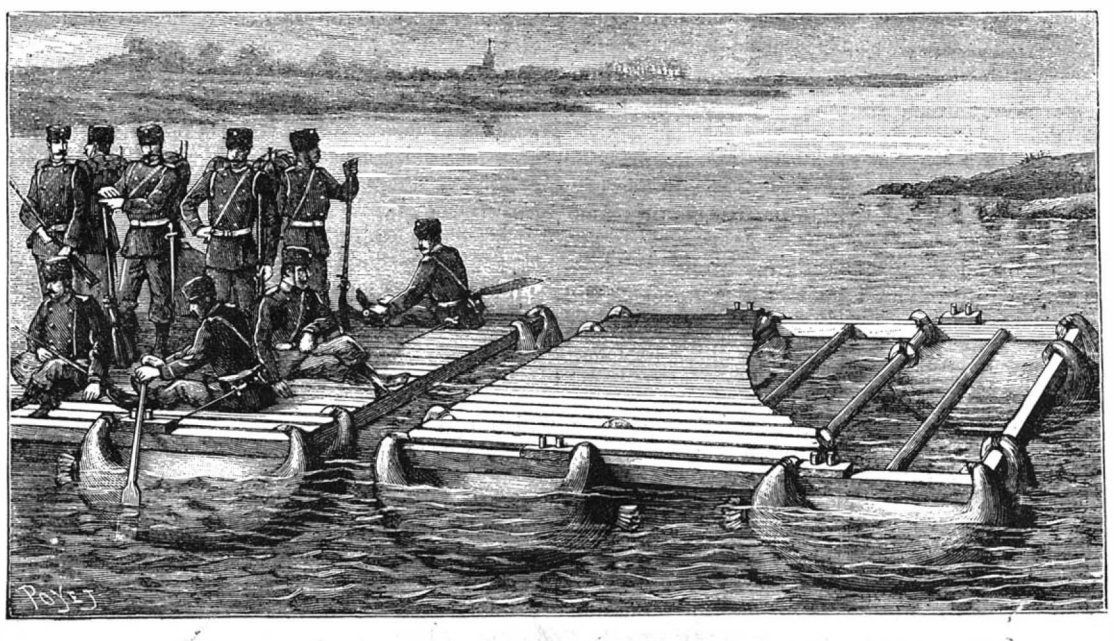


Fig. 3.—MILITARY RAFTS FORMED OF LEATHERN BOTTLES.

THE Master Car Builders' Association recommend a drop test for ascertaining the strength of car couplers. The Buckeye Malleable Iron Co. has constructed a drop machine for testing the Buckeye coupler made by them. One or two couplers out of every heat are tested in this drop, and the lot is rejected if those selected do not stand. The machine consists of an upright frame, in which a 1,640 lb. weight moves, something like a pile driver. Three drops of 10 ft. and two of 15 ft. are used. The coupling iron is placed in the machine, knuckle up, and the weight drops upon it.

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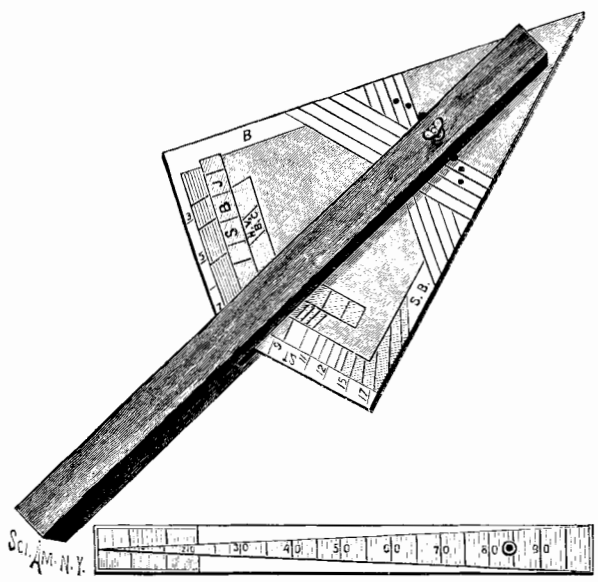
A MEASURING AND DRAWING TOOL.

A readily adjusted and easily applied tool for conveniently finding bevels, pitches, degrees, and lengths in framing roofs and similar purposes, is shown in the accompanying illustration, and has been patented by Mr. L. O. Allred, Palestine, Texas. The larger view is a partial representation in perspective, and the smaller one is a plan view of the straight edge. Pivoted in a slotted bar which forms the straight edge is a plate made in the shape of one-eighth of a regular octagon, with two sides of equal length intersecting at the acute angle and two other sides of equal length intersecting at the obtuse angle, the long and short sides forming a right angle or square at their intersections on either side. The plate has a series of apertures to receive the pivot bolt connecting it with the straight edge, and the upper edge of the latter indicates on various graduations and scales on both faces of the plate. On the faces of the plate are also arranged tables for figuring lengths. The edges of the sides of the plate have marginal lines marked B, SB, T, ST, for blade, sub-blade, tongue, and sub-tongue, and the mar-

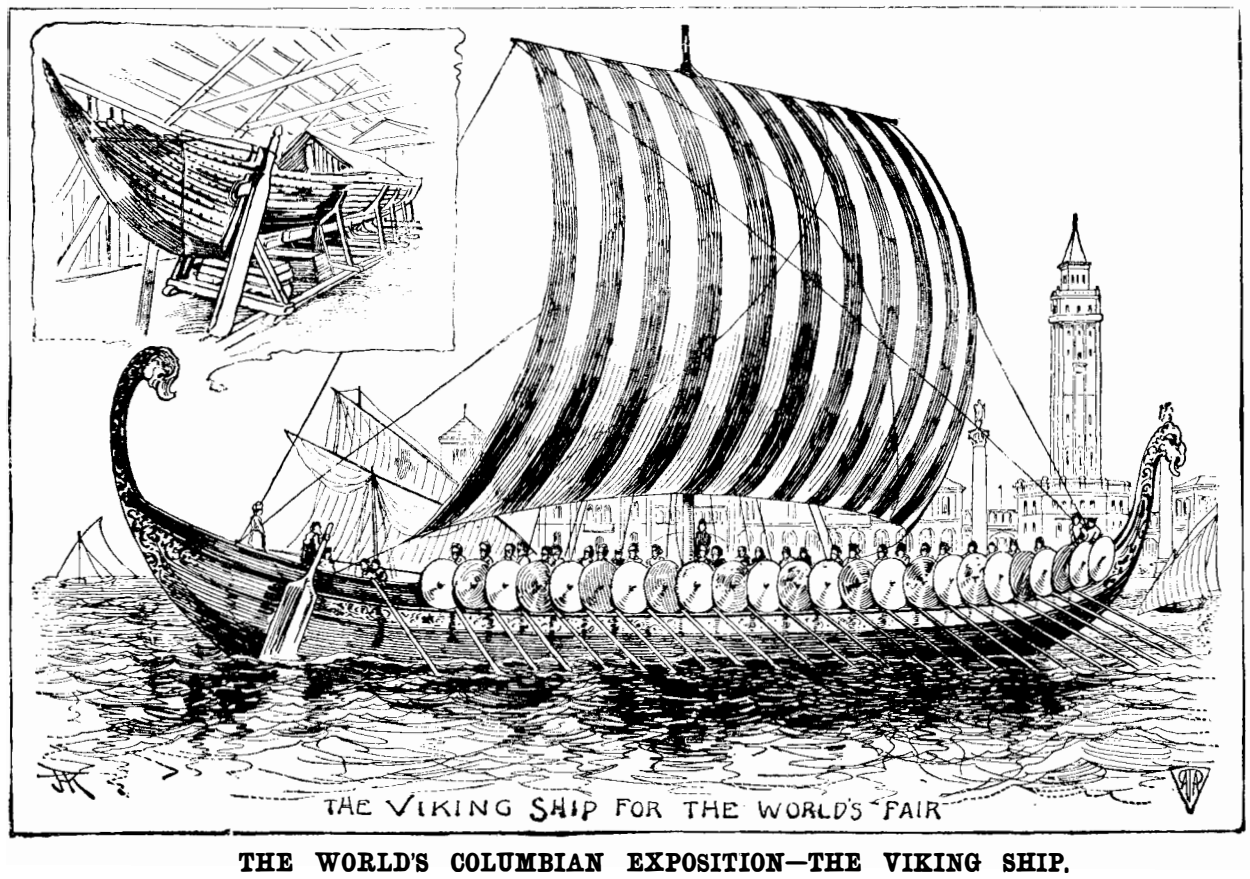


ALLRED'S MEASURING AND DRAWING TOOL.

gins are divided by lines indicated by even and uneven numerals, the lines being drawn from the centers of correspondingly marked apertures in the plate forming pivotal points of the straight edge, by means of which the rise, pitch, and run of a roof may be indicated. Numbers on the tongues and sub-tongues, and in rise columns, have the same meaning as corresponding figures at pivotal points or centers, and when the tool is set for a certain pitch of roof or rafter, the blade shows the bottom or lower end cut of the timber, and the tongue the upper end cut. Every pivotal point on either face of the plate is a center from which the tool can be set and used for laying off correctly a square, square miter, octagon, octagon miter, degrees, etc.

A VIKING SHIP.

Within a comparatively recent period the remains have been dug up, at various places in Norway, of ancient Scandinavian vessels, models of which are to be exhibited at Chicago. Our illustration represents one of these models, which has recently sailed for America, after visiting most of the towns on the Norwegian coast. It is an exact copy of an old Viking vessel, the remains of which were discovered in 1880, near Sandefjord, Norway. The model is splendidly built, of the best materials; but it is said that the modern work in no way surpasses the original, so far as that has been preserved. Not a little apprehension has been felt at the risk of an Atlantic voyage with such a vessel, the original Viking vessels having been intended only for cruising along the European coast and in the Mediterranean, where they made numerous voyages during the ninth, tenth, and eleventh centuries. The great lug sail has been made in four parts, laced together, and reefing consists in removing one portion and lowering the sail accordingly. The men have to sleep on the bottom boards, and provisions are carried in tinned iron cases. All decorations, such as the shields, dragon's head and tail, etc., were stowed away, and fenders were fixed along the sides. The rudder, which is placed at the side, is said to prove quite as effective as a modern one placed at the stern. The vessel is 74 feet long between stem and stern, 16 feet broad amidships, and draws 5 feet of water, its original being by far the largest craft found from the olden times. Local tradition in the neighborhood where the remains of the ancient vessel were dug up had it that here was the last resting place of a mighty king, who had been buried with costly treasures near his body.



THE WORLD'S COLUMBIAN EXPOSITION—THE VIKING SHIP.

SIMPLE HYGROSCOPE.

BY GEO. M. HOPKINS.

In the sultry days of summer we hear a great deal about humidity. This means great discomfort to almost every one.

To be really comfortable on a hot summer's day we do not need shade, cooling drinks, and fans so much as dry air. When the air is dry, nature's method of cooling by spontaneous evaporation of moisture from the skin is carried on to the comfort and satisfaction of those who are compelled to spend the heated term in a warm climate; but when the air is overcharged with moisture nature's cooling process ceases and discomfort results.

To determine by observation how thermal and hygroscopic conditions are related to the enjoyment of existence in hot weather, it is necessary, in addition to a thermometer—which nearly every one possesses—to have a hygroscope or hygrometer of some kind that will either indicate the hygrometric state of the air or afford a means of actually measuring the percentage of moisture in the air.

The annexed engravings illustrate a hygroscope—which may be used for measuring the moisture in the air with tolerable accuracy, and which might therefore be called with equal propriety a hygrometer.

The instrument depends for its action on the expansion and contraction of a strip of cardboard (Bristol board), formed into a helix and rendered impervious to moisture on the outer surface. The helix is rigidly held at one end while the opposite end carries an index which moves over a graduated dial.

The simplest form of the instrument is shown in Fig. 1. In this the upper end of the helix is glued to a cork which fits tightly on the wire projecting from the center of the dial. The lower end of the helix is cemented to a paper index which is perforated to receive the wire. To reduce friction, the hole in the index is black-leaded by twirling in it the point of a very soft lead pencil.

The form shown in Fig. 2 (in which parts are broken away) is like that already described, except in the manner of supporting the helix and in the arrangement of the index. The index in this case is attached to a common needle or pin, which passes through hole in the center of the dial and is inserted cork in the end of the helix. In the end of th farthest from the dial is glued a cork, which i ported by an angled wire projecting from the ba the dial.

When the cardboard helix is as dry as it can made a zero mark is drawn opposite the point of t index, and on a very damp and sultry day the instru-

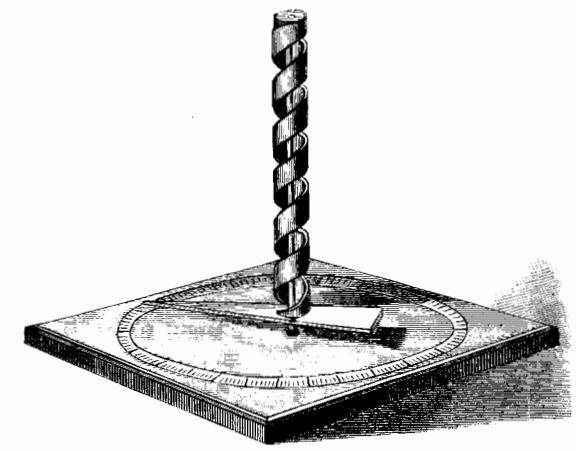


Fig. 1.—SIMPLE HYGROSCOPE.

ment is placed in a steamy atmosphere until the index has moved as far as it will go from the zero mark; the coil is then inserted in the mouth without bringing it in contact with the tongue or lips, when it is breathed upon until the index stops moving and a mark is made opposite the point of the index. This mark is numbered 100, as it is assumed that the atmosphere surrounding the helix at the time of making the 100 mark was saturated. The space between the 0 and 100 marks is now divided into 100 equal parts. The helix must be fixed so that it will not change its position relative to the scale, otherwise the adjustment may be lost.

The percentage of moisture in the air will be indicated by position of the index on the dial. If it points to 75, the air is within 25 per cent of saturation. If 80, 20 per cent, and so on. The index makes something more than a half turn between 0 and 100.

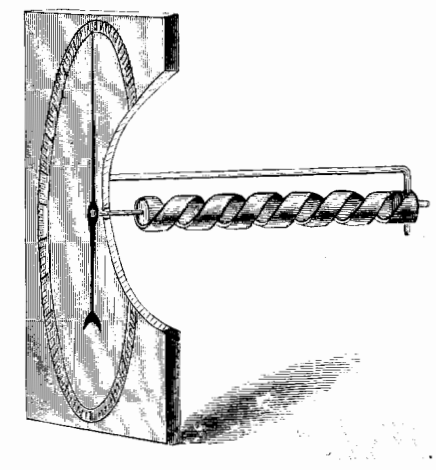


Fig. 2.—SENSITIVE HYGROSCOPE.

The important part of the instrument is the paper helix, but its preparation is very simple. A strip of thin Bristol board, ¼ inch wide and 6½ inches long, is wet on one side and wound on a lead pencil or similar object, with the dry side next the pencil. The ends are secured by winding a small rubber band several times around the pencil, as shown in Fig. 3.

When the paper helix thus formed is perfectly dry and before it is removed from the pencil the outer surface only of the cardboard is covered with two coats of

Fig. 3.—FORMING THE HELIX.

shellac varnish, the first coat being allowed to dry thoroughly before the second is applied.

The helix is now allowed to remain in a warm dry place for a week or more, to allow the varnish to become perfectly dry and hard. Neglect of this last precaution will insure failure, as the paper will not return to its original form after being expanded unless the varnish is hard.

A SOLDER FOR ALUMINUM.—R. Heaton.—The solder is an alloy of aluminum and tin, suitable proportions being 45 parts tin to 11 parts aluminum. The metals are melted separately, poured together, and then cast into suitable strips or ingots. No flux is required.

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First Public Exhibition of Edison's Kinetograph.

At the regular monthly meeting of the Department of Physics of the Brooklyn Institute, May 9, the members were enabled, through the courtesy of Mr. Edison, to examine the new instrument known as the kinetograph. The instrument in its complete form consists of an optical lantern, a mechanical device by which a moving image is projected on the screen simultaneously with the production by a phonograph of the words or song which accompany the movements pictured. For example, the photograph of a prima donna would be shown on the screen, with the movements of the lips, the head, and the body, together with the changes of facial expression, while the phonograph would produce the song; but to arrange this apparatus for exhibition for a single evening was impracticable. Therefore, a small instrument designed for individual observation, and which simply shows the movements without the accompanying words, was shown to the members and their friends who were present.

Mr. George M. Hopkins, president of the department, before proceeding to the exhibition of the instrument offered a brief explanation, in which he said: "This apparatus is the refinement of Plateau's phenakistoscope or the zootrope, and like everything Mr. Edison undertakes, it is carried to great perfection. The principle can be readily understood by any one who has ever examined the instrument I have mentioned. Persistence of vision is depended upon to blend the successive images into one continuous ever-changing photographic picture.

"In addition to Plateau's experiments, I might refer to the work accomplished by Muybridge and Anschuetz, who very successfully photographed animals in motion, and to Demeny, who produced an instrument called the phonoscope, which gave the facial expression while words were being spoken, so that deaf and dumb people could readily understand. But these instruments, having but twenty-five or thirty pictures for each subject, could not be made to blend the different movements sufficiently to make the image appear like a continuous photograph of moving things; the change from one picture to the next was abrupt and not realistic. In Mr. Edison's machine far more perfect results are secured. The fundamental feature in his experiments is the camera, by means of which the pictures are taken. This camera starts, moves, and stops the sensitive strip which receives the photographic image forty-six times a second, and the exposure of the plate takes place in one-eighth of this time, or in about one-fifty-seventh of a second. The lens for producing these pictures was made to order at an enormous expense, and every detail at this end of the experiment was carefully looked after. There are 700 impressions on each strip, and when these pictures are shown in succession in the kinetograph the light is intercepted 700 times during one revolution of the strip. The duration of each image is one-ninety-second of a second, and the entire strip passes through the instrument in about thirty seconds. In the kinetograph each image dwells upon the retina until it is replaced by the succeeding one, and the difference between any picture and the succeeding one or preceding one is so slight as to render it impossible to observe the intermittent character of the picture. To explain in a very imperfect way the manner in which the photographs are produced, I will present the familiar dancing skeleton on the screen. You will notice that the image appears to be continuous, but the eye fails to observe the cutting off of the light, and the image simply appears to change its position without being at all intermittent; but when the instrument is turned slowly, you will notice that the period of eclipse is much longer than the period of illumination. The photographs on the kinetograph strip were taken in some such way as this. I will exhibit an ordinary zootrope adapted to the lantern, which shows the principle of the kinetograph. In this instrument, a disk having a radial slit is revolved rapidly in front of a disk bearing a series of images in different positions, which are arranged radially. The relative speeds of these disks are such that when they are revolved in the lantern the radial slit causes the images to be seen in regular succession, so that they replace each other and appear to really be in motion; but this instrument, as compared with the kinetograph, is a very crude affair."

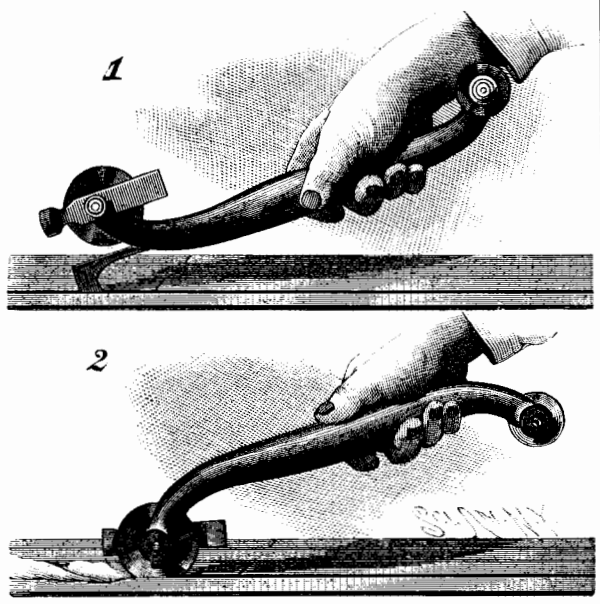
After projecting upon the screen a few sections of the kinetograph strip, the audience—which consisted of more than 400 scientific people—was allowed to pass by the instrument, each person taking a view of the moving picture, which averaged for each person about half a minute. The picture represented a blacksmith and two helpers forging a piece of iron. Before beginning the job a bottle was passed from one to the other, each imbibing his portion. The blacksmith then removed his white hot iron from the forge with a pair of tongs and gave directions to his helpers with the small hand hammer, when they immediately began to pound the hot iron while the sparks flew in all directions, the blacksmith at the same time making intermediate strokes with his hand hammer. At a signal from the smith, the helpers put down their sledge hammers, when the iron was returned to the forge and another piece substituted for it, and the operation was repeated.

In the picture as exhibited in the kinetograph, every movement appeared perfectly smooth and natural, without any of the jerkiness seen in instruments of the zootrope type which have heretofore been exhibited.

The machine in this case was not accompanied by the phonograph, but nevertheless the exhibition was one of great interest. The kinetograph in this form is designed as a "nickel in the slot" machine, and a number of them have been made for use at the Columbian Exhibition at Chicago.

AN IMPROVED CALKING TOOL.

To calk the seams of vessels, tanks, or any article which is to be made watertight, the simple and inexpensive tool shown in the illustration has been devised and patented by Mr. Joseph O. Walton, the tool being also adapted to dig out the calking from old seams when necessary. The handle is shaped to fit the hand nicely, and in its outwardly curved ends are pivoted rollers adapted to run in a seam and jam the calking material into place. One roller has a smooth face and is preferably slightly convex, and the other roller has a grooved or concaved face, forming sharp edges on opposite sides of the groove, enabling it to pack the calking very snugly in a seam, as shown in Fig. 2. The rollers may be made in different sizes to fit different seams if desired. In a longitudinal groove and depression at one side of the handle is pivoted a hook, which lies within the groove when not in use, or may be moved into the position shown in Fig. 1 for use in removing old packing. The pin which forms the pivot of one of the rollers has also pivoted upon it an auxiliary tool or chisel, having at one end a chisel edge and



WALTON'S CALKING TOOL.

at the other a head which may be struck by a hammer, to force calking into a short or transverse seam where the rollers cannot be conveniently operated. This tool may be fastened in the desired position by a thumb nut, and is ordinarily held nearly parallel with the handle, as shown in Fig. 2. The edges of the grooved roller also act somewhat like a chisel, packing the calking as firmly as if a chisel were used, and much more rapidly. Further information relative to this improvement may be obtained of Messrs. Robbins & Graham, Titusville, Fla.

Electrical Process for Boiler Preservation.

Demonstrations of the efficiency of a new method of cleansing and preserving steam boilers against pitting and general corrosion were made on board the steamship Tenasserim, Glasgow, by the Electric Anticorrosion Company, of Cardiff. The process consists of fixing electrodes in the boilers and sending periodically currents of electricity through them under definite conditions, adjusted and controlled by apparatus which is automatic in its action. When the current is passing from the anodes suspended in the boiler to the shell, hydrogen is liberated on the shell and tubes, and oxygen on the anodes; then by means of the depolarizing apparatus the action is changed, and most of this hydrogen and oxygen recombine, the result being that during the first period the hydrogen performs two distinct functions; first, it disintegrates mechanically by its volume the scale formed on the shell and tubes; and, secondly, some of the hydrogen combining chemically with the oxygen of the oxide of iron on the shell and tubes reduces this oxide to metallic iron, thus doing away with the oxidation of the boiler without wearing away the metal. The secondary action, in short, is to facilitate the disintegration of the scale, hasten the mechanical action of the hydrogen in bursting it off, and prevent polarization of the shell and tubes. Oxidation, it is well known, cannot take place in presence of hydrogen gas; consequently, the patentees contend that it will be impossible for corrosion or pitting to take place on the interior surfaces of the boiler so long as this electrolytic aetion is maintained; and, further, the mechanical action of the hydrogen, which is capable of disintegrating the scale, will likewise prevent its reformation.

The practical result of the application of the process is that after the apparatus has been working in an old boiler for a few months, the scale is said to be completely removed, and the surface of the iron is brought into sound and healthy condition by a deposit of metallic iron being formed on the shell and tubes. Where no lighting installation exists, the patentees fix a suitable dynamo, which may be driven from the screw shaft, and be of sufficient capacity not only to supply the boilers, but also to light up the engine room. It would seem to us, says the *Engineer*, that the dynamo had better be employed all the time in this lighting, and the boilers would be best preserved by feeding them with pure water.

Joseph Francis—Inventor of the Life Boat.

Joseph Francis, inventor of the metallic life boat, the life-saving marine car, and other useful inventions, died at Otsego Lake, N. Y., on the 10th of May, at the ripe old age of more than 92 years. He was born in Boston, Mass., March 12, 1801. When quite a lad he exhibited mechanical talent, and later on was the author of various mechanical novelties.

His greatest achievements were in the construction of life-saving appliances. These consisted of life boats, life cars and surf life boats. Of the life boats, the first that he made was of wood, and was called the hydrogen life boat. The interior was fitted with copper air tubes, and the invention proved successful. As a result of later experiments, the use of wood in the construction of his boats quickly gave way to iron, although the use of iron in the manufacture of vessels of any kind was practically unknown at that time. To Mr. Francis may be conceded the first use of iron floating vessels. Another improvement was added by having the spaces at the bow and stern of the boats made into reservoirs of air, as well as the spaces at the sides, thus enabling the boat to sustain a great load in the heaviest sea.

The New York *Sun* says: "The venerable inventor who died at Otsego Lake on Wednesday morning, in his 93d year, had rendered a conspicuous service to mankind, which was long since fittingly honored in foreign countries and more tardily in our own. In the Blue Parlor of the White House, just three years and one month ago, Joseph Francis received at the hands of President Harrison, after an address by Mr. Evarts, a gold medal which had been voted to him by Congress. It was a massive and handsome tribute, the largest medal, we believe, ever given by our government. Three pounds of solid gold were in it.

"That medal told the great work of Joseph Francis' career, in its representation of the metallic life car which rescued the passengers of the Ayrshire. 'You have made it possible,' said the President, in giving it, 'for the shore to send succor to the ship. You have invented and suggested appliances that have saved many thousands of human lives.'

"It is a little odd that Francis as a lad, before he had reached his teens, playing on the wharves of Boston, had fitted up a small boat with cork in bow and stern, which has been not unfairly called the first life boat built in America. The attention given to it, with his subsequent devotion to boat building, set all his faculties at work in that direction.

"When as a young man he came to New York with an unsinkable rowboat, containing cork at the ends and air tubes along the sides and under the thwarts, and gave an exhibition of it in the river at the foot of Wall Street, his career was determined. England, Russia, and Brazil bought such boats of him. But he had another idea working in his mind for saving life on wrecked vessels, and as early as 1838 constructed a wooden car to run forth and back on a hawser, between ship and shore. That, however, did not work well, being dashed to pieces on its trial; and then, in 1842, Mr. Francis achieved his great success of a corrugated iron water-tight car.

"Years passed in attempts to interest the government in this device, with the result only of obtaining permission to try it at the life-saving stations. On the 12th of January, 1850, the British ship Ayrshire came ashore at Squan beach, on the New Jersey coast, with about 200 souls aboard. The life car was near by and was hauled out to the ship. Five persons entered it and landed safely; then another five, and another, till about twoscore trips were made, and every person was saved, except one man who had attempted to ride outside the car and was washed off.

"Honors to Mr. Francis followed from France, Austria and Russia, and from that time forward his life cars and pontoon wagons yielded a comfortable livelihood. In 1885 the New York Chamber of Commerce urged a testimonial to him from Congress, and this was at length secured. In former years a familiar figure at the Stevens House, in lower Broadway, he has passed away at a good old age, after a life made happy by thoughts of the good he had been able to do to his fellow men."

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Correspondence.

Do the Rings Indicate the Age?

To the Editor of the Scientific American:

I have just read in the Leavenworth (Kan.) *Standard* of a huge walnut log now at the World's Fair, from Leavenworth County. The dimensions are not given, except that it is 16 feet long. It weighs 30,000 pounds. It is claimed to be the largest walnut log on the continent, if not in the world. On a transverse section of the log 572 concentric rings may be counted, and from this it is claimed that the tree was 572 years old when it was cut down. Do the rings indicate the age?

N. T. ALLISON.

Columbus, Kan., April 29, 1893.

It has been well established by cutting trees of known age that the rings indicate the annual growth. —ED. S. A.

Improved Country Roads and Electric Transit.

To the Editor of the Scientific American:

I read with some interest your page article on "Country Roads and Electricity." The subject of improved roads has the support of intelligent citizens as well as the wheelmen. Though I believe the county system the best solution of our road problem, I argued before the Senate Finance Committee in favor of a State system of two roads each way through every county, because it is necessary by some such radical measure to give the impetus and furnish each community with the object road. As for the imputation contained in your article as to the folly of so expensive an undertaking, if you will perform the mathematical problem of the proportionate share of such a system on each thousand of assessed valuation, you will find that the ten millions provided for by the Richardson bill, with carrying charge, and cost of repair figured at three hundred per mile, and sinking fund obliterating the principal in twenty-five years, with no account of increased valuation, distributed upon our four thousand million State valuation, would be about two cents per year per thousand dollars valuation for the twenty-five years. We could build 3,000 miles at ten thousand a mile, the proved cost of the Richmond and Queens County Telford roads, for thirty millions, being for the same period approximately a tax of six cents per thousand dollars valuation. The increased valuation of the State in this period would be likely to offset cost of new construction. Would it not be worth while for this State to have so comprehensive a system of improved roads, with their resulting effect and benefit to each community and the State at large? Every argument in your article is equally an argument for the improved road. Those of us who are moving in this surely have enough to overcome without meeting, as is indicated in your article, the argument that we are blocking progress. I believe that in the future extended systems of electric roads will go out into the country as soon as the population warrants it. I believe also that the improved road will lead to an increased country population and one much more progressive and likely to embrace better forms of communication, as, *e. g.*, electric—but such electric roads must run upon the sides and not upon the roadway. It would be a monstrous use of the roadway, which is only tolerable on the ground of convenience and necessity in the cities, and which has no place in the more enlarged and freer dimensions of the country road. It would undoubtedly cost more to lay the rails properly upon a macadamized road. It is equally true that it would cost practically double to do the same in any roadway to the construction necessary to make a more satisfactory road with T rail along the side of the country highway. A good macadam roadway for driving and ordinary traffic, bordered by an electric road, neither interfering with the other, affords an ideal system of intercourse between places, and one that does not mar the beauty of the highway nor its common use. Such exists here between Rochester and Charlotte, on the boulevard, so called.

I trust that a paper of your character will not hinder the agitation for good roads, which are a crying necessity of this State, by such arguments as are put forward in the article in question.

JOHN A. C. WRIGHT.

Wire-Wound Guns.

The British Admiralty, says the *Army and Navy Register*, has just adopted the new wire-wound, quick-firing six inch breech-loading gun for the navy. The new weapon is forty calibers long and weighs seven tons. It will fire an elongated projectile weighing 100 pounds a distance of over four miles. It is such a quick-firing gun that at long range when fired with cordite it has three or four shots in the air at the same time. Forty of the new guns have been manufactured at Woolwich and are being issued and mounted in ships in the British navy. The new gun is a breech-loading rifled gun having a muzzle velocity of 2,600 feet per second.

In this connection it is interesting to note that it is expected trials will be made at Sandy Hook, during April and May, of two wire-wound American cannon. One is the Woodbridge ten inch gun built at the Watertown arsenal under the supervision of the inventor, Dr. W. E. Woodbridge. The gun consists of a continuous steel tube, overlaid throughout its rear half with a cylinder of closely fitted steel staves, the whole wound with tinned steel wire, to be soldered or brazed in an oven. The whole length of the gun is divided into three sections by steel rings or bands, and forward of the staves the wire is wound directly upon the steel tube.

Another wire-wound gun, the Crozier ten inch rifle, designed by a young officer of the Army Ordnance Department, whose name is given to the gun, is nearly ready for trial. It was built at the Watervliet factory and consists of a steel tube, overlaid from breech to muzzle with a practically continuous covering of steel wire, wound in layers, with a jacket cylinder enveloping the steel wire over the re-enforce, and a continuous layer of steel hoops covering the wire from the trunnion band forward to the muzzle. The coils of wire are electrically welded, end to end, so that the gun is wound with a continuous strand of wire. The breech mechanism is of the usual service type.

The ordnance experts have taken every precaution in constructing these wire-wound rifles to overcome the most obvious weak point of this type of gun, which lies in insufficient longitudinal strength. The friends of the wire-wound weapon look upon it as a formidable rival of the so-called built-up guns. The wire-wound gun does not necessitate the handling and finishing of the great forgings required in the built-up constructions. It is also claimed that such a gun could be built both more quickly and more cheaply.

The New York and Chicago Twenty Hour Train.

The New York Central has given out a definite announcement of its new train to Chicago, which will begin running May 14. The time of leaving New York is 3 P. M., and of arrival in Chicago 10 A. M., making the running time 20 hours actual, 19 hours apparent time. There is to be an east bound train also, which will run at the same speed, leaving Chicago at 2 P. M. and arriving in New York at 11 the next morning. The distance through is 965 miles. About 10 miles at Chicago has to be traversed at reduced speed, so that the fast running must be done in about 19½ hours in a distance of 955 miles. This will mean just about 49 miles an hour, as against the 50·7 miles an hour of the Empire State Express. The train will probably consist of three sleeping cars and a combination smoking and baggage car, except when a dining car is taken on. This will probably be, going west, from Albany to Syracuse and Toledo to Chicago.

As every one knows, the New York Central and the Lake Shore make up the most favorable route between New York and Chicago for high speed. From New York to Albany the grades are very easy, although there are a good many curves for the first half of the distance. From Albany to Buffalo the curves and grades are not only very easy, but there are separate tracks for freight trains all the way. The only serious exception to this is the three mile ascending grade out of Albany, going west, where a helping engine has to be used. The Lake Shore has even a larger percentage of straight line than the New York Central, there being one tangent 70 miles long. This road is also practically double track throughout, there being, we believe, only one 14 mile stretch (between Toledo and Elkhart) where the second track is not finished. Track tanks have been put in at five different points, so that the trains will make regular stops only at Erie, Cleveland, Toledo and Elkhart. We believe there are one or two drawbridges between Cleveland and Toledo at which trains have to come to a stop, but the numerous grade crossings of railroads along the line are said to be all provided with interlocked signals.

In the matter of safety at facing point switches the Lake Shore, is, however, far behind the New York Central. The latter has distant signals of some kind at practically all such switches, but on the Lake Shore nearly all the switches are entirely unprotected except by the ordinary target and lamp. In fair weather and daylight most of these switches are probably visible several hundred feet away, but in fogs and storms and, to a less degree, in the uncertainties that always exist from sundown until dawn the next morning, the enginemen of these trains will have a perplexing dual responsibility—to obey the rules and yet make time. The Lake Shore road is arranged on the principle so commonly followed in the level portions of the country, that distant signals are needed only at obscure points, and that this definition means points which are always obscure, and as on most other roads, especially in the West, even this principle is in many cases neglected. Where trains run regularly at the high speeds we are now considering, the true principle is to treat all switches and other like dangerous points as though they were always obscure, that is, provide distant signals for them.

The new "flier," it will be seen, differs from the Empire State Express in several respects. It undertakes to keep up this remarkable speed more than twice as long, the rate, however, being a trifle slower. It will run about two-fifths of its trip in darkness, whereas the other train has daylight all the way except for two months in the winter. With three sleepers it will be a heavier train, even without the dining car. And last, but not least, it will depend for its profit largely, and probably chiefly, upon through passengers, which are comparatively few, while the remarkable prosperity of the Empire State has come from passengers who travel only from one stopping place to the next. It is said that the competitors of the Vanderbilt lines demand that the fare by the new train be made $30 through—fifty per cent above the regular rate.—*Railroad Gazette.*

The Incandescent Gas Light.

The brilliancy of gas light is greatly increased by causing a mixture of burning gas and air, as in the Bunsen burner, to impinge upon a lamp wick with which certain mineral substances have been combined. Nearly all the metals of the cerium and lanthanum groups have been experimented upon, and at the present time the following minerals are employed in this manufacture: Monazite, which contains 70 per cent of the oxides of cerium, lanthanum and didymium, in combination with phosphoric and silicic acids, thorite and orangite, which contain a large percentage of thorium oxide, gadolinite and orthite, minerals which contain 35–45 per cent of yttrium oxide in combination with zirconia and oxides of the cerite metals. From McKean's experiments the accompanying table has been drawn up to show the variation in the color of the light emitted from wicks or mantles made from these oxides in different proportions:

Color.	Ceria.	Didymia.	Erbia.	Lanthana.	Niobia.	Thoria.	Yttria.	Zirconia.
White	—	—	—	40	—	20	—	40
	—	—	—	60	—	—	—	40
	—	—	—	—	—	80	20	—
Yellow	2	—	—	40	—	28	—	30
	3	—	—	50	—	—	—	47
Orange	—	3	—	40	—	30	—	27
	—	—	—	50	10	40	—	—
Green	—	—	30	20	—	50	—	—

The oxides of lanthanum and thorium are used to a greater extent than the other oxides, and the green color which is a marked characteristic of some of these mantles is due to the presence of erbium oxide. The oxides of didymium, niobium, and yttrium are seldom used, and have no very marked influence on the general color of the light.

The intensity of the light emitted by the various metals has also been recently investigated. Mantles of the different oxides were prepared in a similar manner, and used in the same burner. Gas was supplied to the burner at the rate of 85 liters per hour under a pressure of 25 mm., and the intensity of the light determined in terms of the standard "Hefener" lamp.

The following figures were obtained:

Mantle.	Standard.	Color.
Thoria	31·56	Blue white.
Lanthana	28·32	White.
Yttria	22·96	Yellow white.
Zirconia	15·36	White.
Ceria	5·02	Red.

The best light effect is obtainable from a mixture of two-thirds thoria and one-third yttria, while, if the blue tinge of the color is not objected to, the maximum amount of light is obtained from a mantle made only from thoria.

The Largest Dredger in the World.

The Naval Construction and Armaments Company recently launched from their shipbuilding yard at Barrow a twin screw hopper and sand pump dredger named Brancker. This vessel has been built to the order of the Mersey Dock and Harbor Board, who have been so satisfied with the experiments made in cutting a channel through the Mersey Bar that they have determined to proceed with dredging operations there, so that steamers of the largest tonnage may be enabled to enter the river in any state of the tide. A vessel on a gigantic scale was designed by Mr. A. G. Lyster, under the direction of Mr. G. Fosberry Lyster, engineer to the board, the following being a general description of her dimensions: Length between perpendiculars, 320 feet; breadth, moulded, 46 feet 10 inches; depth, moulded, 20 feet 6 inches; gross register tonnage, 2,560 tons. She is built of steel to Lloyd's highest class, and has amidships eight large hoppers, four on each side of the vessel, having a total capacity of 3,000 tons of sand. A well is formed up the center of the ship between the hoppers to allow the working of a sand pump suction tube, 3 feet 6 inches diameter, through the bottom of the vessel. This tube is raised and lowered by hydraulic power, and when lowered can dredge to a depth of 45 feet. Two large centrifugal pumps, having suction and discharge pipes 3 feet in diameter, capable of raising 4,000 tons of sand per hour, are driven by two sets of triple expansion engines. The vessel will be able to fill her hoppers with 3,000 tons of sand, proceed to the depositing ground and get back again to the scene of operations in one hour. The Brancker is the largest dredger in the world.

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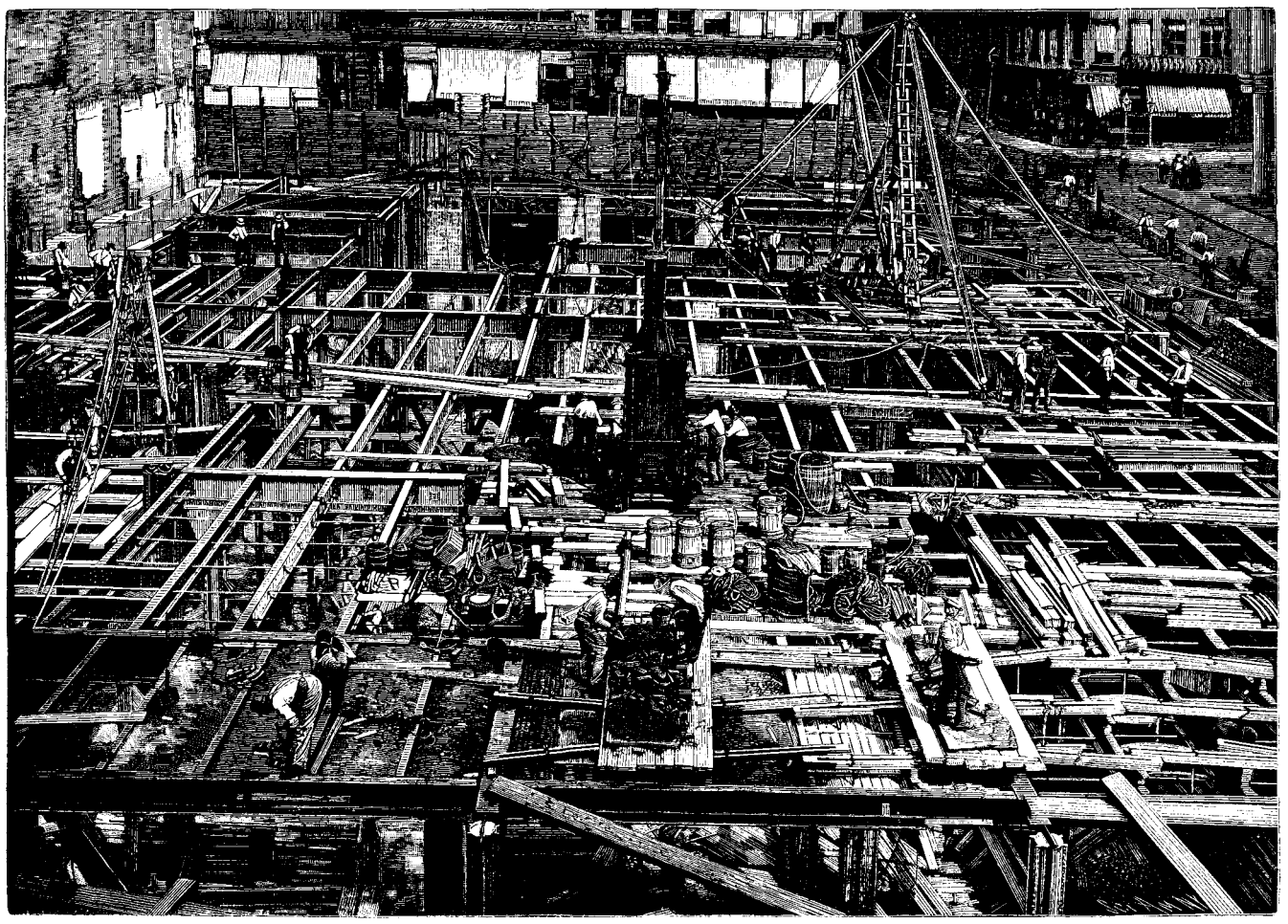
THE BROADWAY CABLE RAILWAY, NEW YORK.

(*Continued from first page.*)

way, corner of Broadway and Houston Street, New York, shows what may be accomplished in strength, stability and freedom from vibration in a building to be devoted to business purposes in all its upper part, while machinery conveying 2,000 or more horse power is being operated in the basement. The building rests on 73 steel columns, the 28 exterior columns resting on grillages of iron I bars on concrete, while the interior columns rest on steel caissons sunk into the water-bearing strata filled with sand and concrete and capped with an iron bar grillage, so that there is no direct connection between the walls that support the machinery and the columns that support the building.

The main floor in the cut shows the mass of beams on the street level, having no connection whatever with the running machinery below, save through the sand of its deep foundation.

The cable grip of the Broadway Cable Railway has all the useful features of a grip suitable for the various emergencies required in a complicated service, and mainly consists of the two vertical strips of steel on the outside—as shown in the cuts—fastened to the bottom section of the grip shoe, which is double, to take the cable on each side, and are also permanently attached to the crosshead on the truck. By this arrangement, with one movement of the operating lever, the cable is taken up on either side of the grip. The narrow vertical pieces—as shown in the cuts—are attached to wedge shaped blocks for disengaging the cable, when the grip jaws are opened, by a lever movement shown in the cut. By this means a transfer is made at the cable loops by dropping the cable on one side of the grip and taking up the next cable line on the other side. The grip crosshead has a side adjustment by a sliding movement on cross bars fastened to the truck frame running on the axles, so that the vertical adjustment of the grip is made with the track, the variable load of the car adjusting the body only by the springs. By the lateral slide of the grip on the cross bars of the truck frame, the cars are enabled to pass around the curves with the grip frame riding free from strain in the slot. The illustration of a car and grip shows the method of attaching the grip to the car truck and the cable as when the car is running. The illustration is from a photograph of car No. 98 making its first trip from 50th St. to Houston St. on the night of May 10.



BROADWAY CABLE RAILWAY—POWER HOUSE CONSTRUCTION.

BROADWAY CABLE RAILWAY—BUILDING ENGINE ROOM BELOW SIDEWALK.

Explosion of Pyroxylin.

The pyroxylin used in pharmacy and the arts, dinitrocellulose, is usually regarded as non-explosive, but C. O. Weber shows how, under certain conditions, it may become dangerous. After preparing some in the usual manner, he added a small quantity of ammonia to the water used for washing, so as to effect complete removal of the acids more rapidly. A copper oven heated to 70° C., used for drying about one ounce of the pyroxylin thus treated, was after three hours' drying torn to pieces by the force of an explosion, the fragments of copper being hurled all over the room. Since pure dinitrocellulose requires a temperature of 194° to 198° for ignition, while hexanitrocellulose only ignites at 160°–170°, it appeared that the explosion must be due to the use of ammonia in the washing process. A little nitrate of ammonia was probably formed and dried upon the nitrocellulose in a state of fine subdivision, and any trace of acid would then suffice to cause the salt to act as a fuse. The use of ammonia in this connection is accordingly to be avoided.—*Jour. Soc. Chem.*

Liquefaction of Osmium.

While certain noted chemists have been striving to compass the liquefaction and solidification of gases hitherto regarded as permanent, others have been working as persistently in the opposite direction by seeking to liquefy the more refractory metals. The metals of the platinum group have presented most difficulty in this respect; but in a recent number of the *Comptes Rendus*, MM. Joly and Vezes explain the means by which they have been enabled to obtain, in the liquid form, osmium, the most refractory element of the group, and the last to yield to experimental skill. Metallic osmium, which occurs as small grayish blue crystals, was heated in the electric furnace of Ducretet and Lejeune, in a carbon crucible, and in an atmosphere of carbon dioxide. At the highest temperature of the electric arc the metal was fused without appreciable loss by volatilization. After fusion it was exceedingly hard, and capable of cutting glass, or scratching quartz, but not affecting the topaz, while it appeared to remain unaffected by the oxygen of the air. It is remarkably like ruthenium in many of its properties, but differs from it in aspect, having a blue metallic luster, while ruthenium is whiter than platinum, and resembles burnished silver.

The Census Returns of Sugar and Rice.

The superintendent of census has issued the statistics of sugar and rice production in the United States, compiled under the supervision of Special Agent Hyde. The total production of cane sugar in the year ending May 31, 1890, was 302,731,895 pounds valued at $12,829,824 on the plantation. The total production of merchantable cane molasses was 25,398,954 gallons, valued at $8,076,575. The total production of rice was 130,019,123 pounds, valued at $3,951,119; 96·5 per cent of the sugar and 58·6 per cent of the rice were produced in the State of Louisiana.

The *Louisiana Planter* says: While the figures seem to be quite exact, they are somewhat misleading in this, that they really only cover the crops of the year 1889, which will long be remembered in Louisiana as a year of unprecedented drought, resulting in an immense falling off in the sugar crop. The Louisiana sugar crop of 1890 was nearly twice as large as that of 1889.

IN A. D. 105 Trajan built a magnificent stone bridge across the Danube 4,770 feet long.

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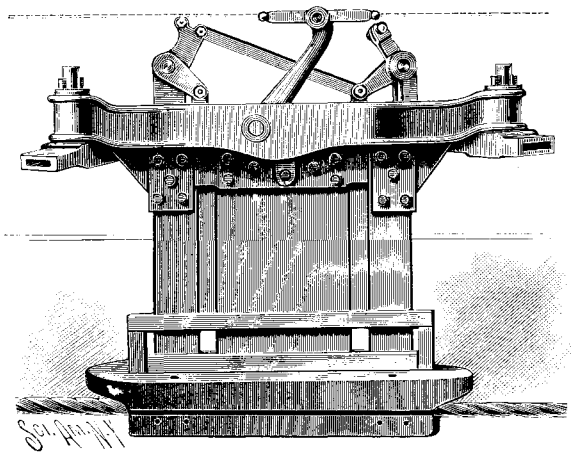
Two New Great Steamers.

We learn from *Engineering* that the White Star Company are negotiating with Messrs. Harland & Wolff, Belfast, to construct for the line two steamers, which are to have a speed in excess of anything now afloat, including the two new Cunarders. It is not yet possible to give details; but it is said the vessels will



CABLE GRIP MECHANISM.

each be something like 60 feet longer than the Cunard vessels. They are to be propelled by three screws. We are informed the stern framing is already under order, so that it is intended to proceed at once with the construction of the vessels. The stern frame is of novel design. The run of the keel has a curved rise in front of the rudder post, as in the case of some torpedo boats, and as it is of heavy section with suitable points for bearings, the intention is evidently to run a propeller in the space left by the curve on the keel plate or bottom part of the stern frame. The massive character of this frame will be appreciated when we state that it weighs about 20 tons. There are brackets for the two side screws, and these weigh 8 tons each. As to the power to be generated by the engines, it is understood to be about 40,000 indicated horse power.

Turkish Great Guns.

In 1478 Mohammed II., in forming the siege of Scutari, in Albania, employed fourteen heavy bombards, the lightest of which threw a stone shot of 370 pounds weight, two sent shots of 500 pounds, two of 750 pounds, two of 850 pounds, one of 1,200 pounds, five of 1,500, and one of the enormous weight of 1,640 pounds, enormous even in these days, for the only guns whose shot exceed the heaviest of these are our 80-ton guns, throwing a 1,700-pound projectile, our 100-ton, throwing one of 2,000 pounds, and the 110-ton, throwing an 1,800-pound shot with a high velocity. The stone shot of Mohammed's guns varied between twenty and thirty-two inches in diameter, about the same height as a dining table; 2,534 of them were fired on this occasion, weighing, according to a calculation of General Lefroy's, about 1,000 tons, and were cut out of the solid rock on the spot. Assuming twenty-four inches as the average diameter of the shot fired at this siege, the total area of the surface dressed was nearly 32,000 square feet. At this siege the weight of the powder fired is estimated by General Lefroy to have been 250 tons. At the siege of Rhodes, in 1480, Mohammed caused sixteen basilisks, or double cannon, to be cast on the spot, throwing balls two to three feet in diameter. — *Chambers's Journal.*

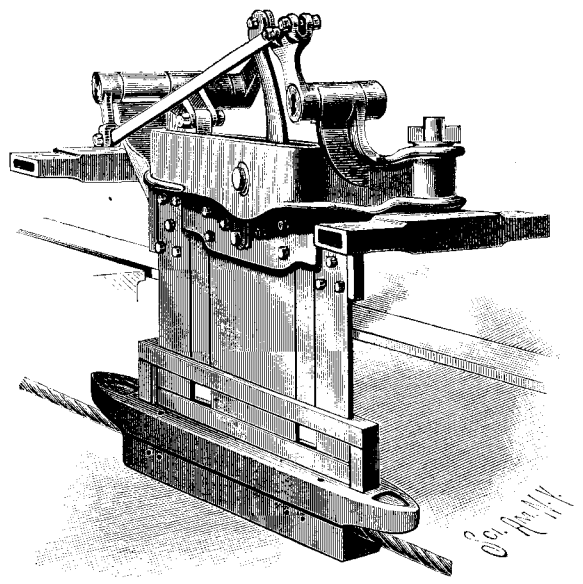
The Mining District of Guanajuato, Mexico.

To many people a Mexican silver mine is close kin to a Spanish castle, but the fact remains that the most productive silver mines of the world are in Mexico; not the most productive at present, but in the gross amount of the metal won in the past.

The mining district of Guanajuato has been an active producer of silver since 1548, and the known amount of metal obtained with the crude and wasteful methods in use approximates $650,000,000. Some of the greatest shafts ever put down are in the vicinity of the city of Guanajuato, one of them being 40 feet in diameter and over 1,400 feet deep. The new shaft of the Bolanitos mine is 20 feet in diameter and 600 feet deep. This mine is said to have produced over $3,000,000 in the six years preceding 1890.

The entire district is permeated with veins of quartz in metamorphic clay slate, nearly all the chief silver-bearing minerals being present. Only the first class ores are worked commercially, those whose assay value falls below $30 per ton not being available for the Washoe or the patio process. The excessive cost of transportation and of fuel militates against the working of any ores of this grade. Packing on mules to the haciendas costs $3.50 per ton, and treatment of the ores $11.50: these two items added to the $12 for mining, hoisting, pumping, sorting, etc., leave but a small margin on a $30 ore.

The unwatering of the lower levels of the mines has attracted considerable attention of recent years, and two companies are now engaged in an undertaking of this kind. The first of these on the ground was an English company, and work has been prosecuted on the San Calletano tunnel for several years. The second is the Victoria Tunnel Company, an American concern, which pro-

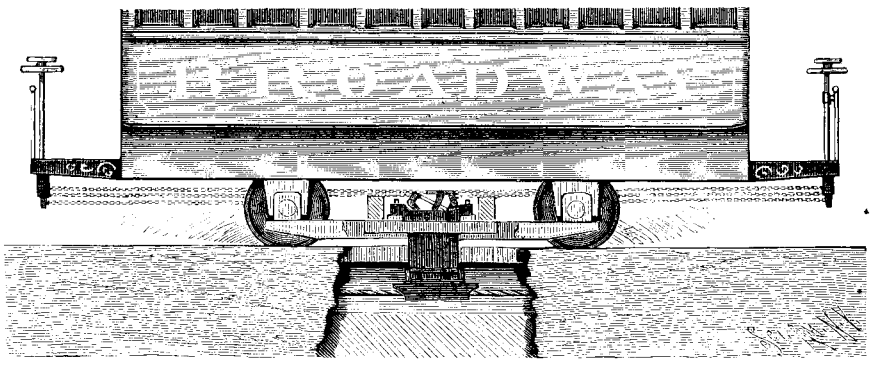


CABLE GRIP MECHANISM.

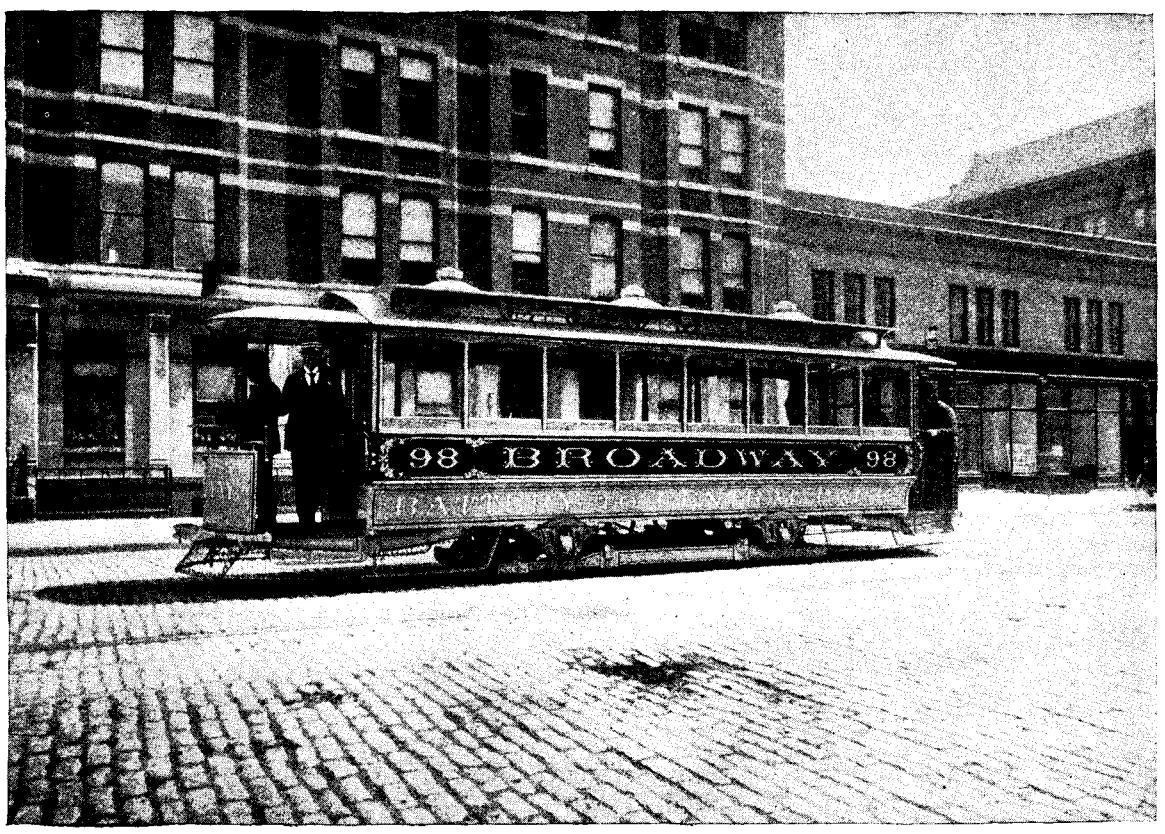
poses to drain La Luz group of mines by a tunnel 7,000 feet in length. This group lies about 12 miles west of north of Guanajuato, and comprises 14 mines, viz., San Barnabe, La Luz, San Jose, Santa Clara, Refugio, San Vicente, La Trinidad, Los Locos, Jesus Maria, Villarino, El Santo Nino, La Purisima, San Pedro and San Nicholas. Up to the end of 1889 the group had been credited with a production of $312,860,000 since 1548.

The main difficulty in the way of the successful treatment of the ores seems to be the excessive cost of fuel. Wood costs $10 and coal $22 per ton, so that the operations, even if the mines can be made dry enough for working, would be restricted to the better class of ores.

It is in respect of such undertakings that the importation of Southern coal and coke into Mexico deserves to be carefully investigated. Coal for domestic consumption will cut but a small figure in Mexico for many years to come, and it is to metallurgical and often industrial enterprises that one must look for a market. —*Eng. and Min. Jour.*



BROADWAY CABLE RAILWAY—GRIP CONNECTION WITH CABLE.



CABLE CAR—BROADWAY CABLE RAILWAY, NEW YORK.

Remarkable Dust Explosion.

Early on the morning of March 21, in the city of Litchfield, Ill., one of the most remarkable dust explosions on record occurred in the "Planet" or Kehlor flour mills. Before the explosion a fire broke out in one of the elevators, and the watchman was unable to send an alarm before the fire had reached the mills. Here it was beyond control. The fire companies, on reaching the scene, got their apparatus connected. By this time the flames had reached the part of the mill where there presumably was an accumulation of dust, and the explosion occurred. The great mill, said to have been the largest flour mill in the world, was blown to pieces as if by dynamite. Bricks, timbers, and pieces of machinery flew in all directions. The spectators of the fire were thrown to the ground by the shock, and people a mile distant were prostrated. Towns sixty miles away telegraphed that they had experienced the effects of the explosion. At Decatur, fifty miles away, the atmospheric concussion was felt. In the town no house escaped injury. Those near the scene had every window blown out. Some houses two miles distant were entirely destroyed. The town bore the appearance of having been swept by a cyclone. The incoming trains brought crowds of spectators.

When Sir Humphry Davy invented the safety lamp which bears his name it was supposed that mine explosions were due to inflammable gas, generally or mostly marsh gas, CH_4. But recently it has been found that coal dust plays a most important role in mine explosions, and the miner's "fire damp" may be interpreted as including coal dust as well as marsh gas. The recent development of steam milling has brought dust explosions more into prominence. In mill explosions there is absolutely no gas. The flour dust is so fine that, mingled with and suspended in air, it produces an explosive mixture. The loss of the mills, which had a capacity of two thousand barrels of flour per day, represents about one million of dollars.

Separation of Flames.

As a supplement to the subject of flames, Professor Clowes recently performed before the Society of Chemical Industry, Nottingham, the experiment devised by Professor Arthur Smithells, of the Yorkshire College, Leeds, of separating the inner from the outer portion of the Bunsen flame, each burning independently of the other. Professor Clowes stated that the experiment he had shown would modify some of the theories of combustion. He would, however, enter into no details, as Professor Smithells would probably give one of the popular lectures at the forthcoming meeting of the British Association in Nottingham.

THE great aqueduct which supplied Carthage with water was seventy miles long.

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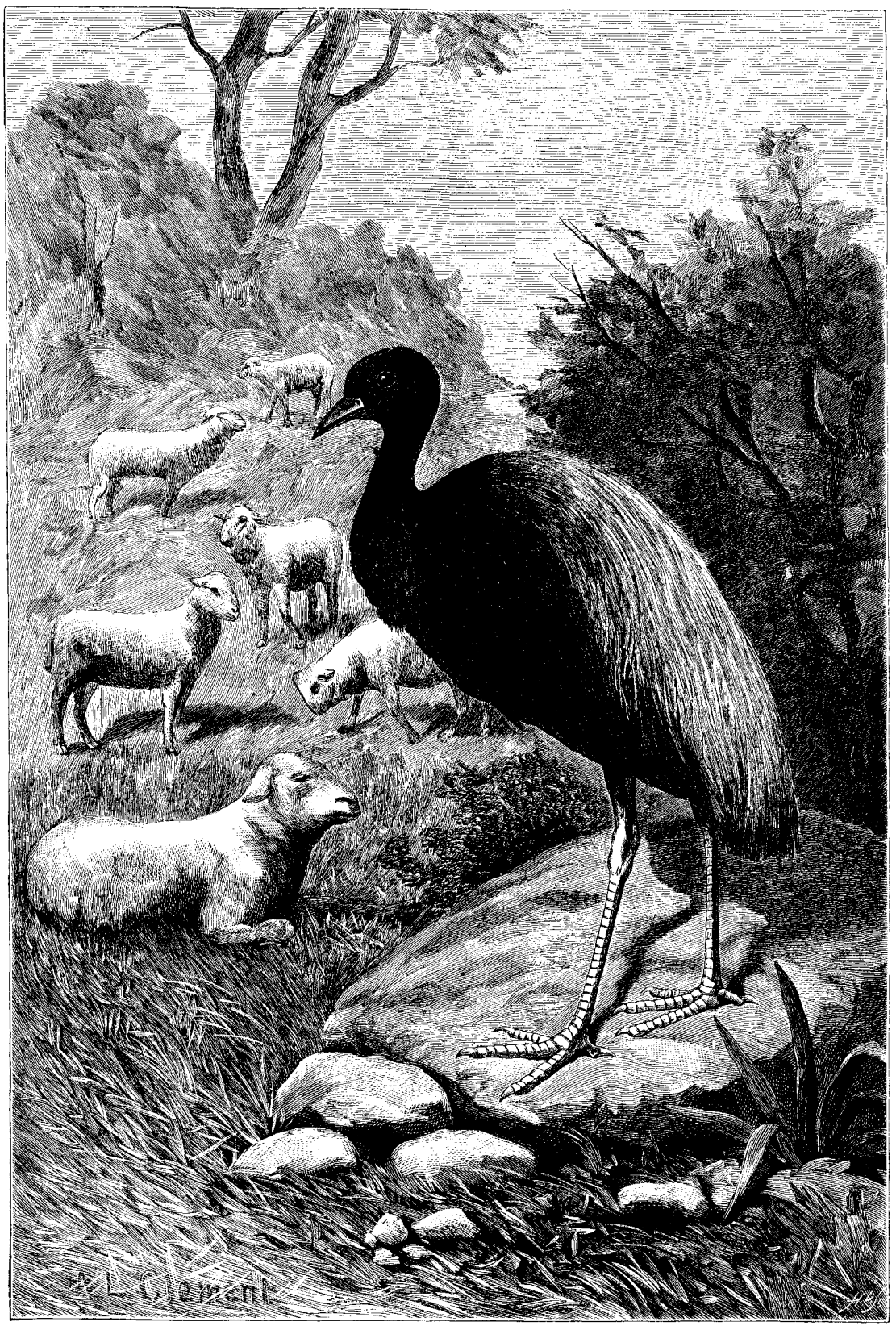
THE TRUMPETERS.

While the Palmipedes and the Gallinaceæ give us valuable auxiliaries, some of European origin, such as the geese, ducks and chickens, and others of foreign origin, such as the turkeys and guinea fowls, the waders at present furnish no domestic animal in our regions. But such was not the case in antiquity, for an examination of the Egyptian paintings and monuments shows us that in olden times, in the valley of the Nile, the gray crane was kept in captivity and treated like poultry yard birds. Nor is such the case in our own day, even, in tropical America, where man has been enabled to utilize the intelligence of certain waders, near relatives of the cranes, and make them protectors of poultry and guardians of sheep. These birds, thus domesticated, are the kamichis, the chaunas and the agamis, or trumpeters. The kamichis or screamers, the largest of all, live in a wild state in the forests of Brazil, Guiana and Colombia. In their general form they somewhat resemble the turkeys, but they have a more elongated body and longer legs, and, instead of caruncles, they are provided on the forehead, toward the base of the bill, with a slender horn, which is adherent only to the skin. Besides, near the carpus, their wings are provided with two sharp spurs, with which they are capable of inflicting severe wounds upon their enemies.

The chaunas of Brazil and the Argentine Republic, smaller than the kamichis, have a shorter bill, a relatively heavier body, stronger legs, a glossy plumage much more strongly mixed with gray and white, the forehead deprived of a horny appendage and the nape often ornamented with a tuft.

Finally, the agamis, with which we shall occupy ourselves particularly at present, and which constitute the genus *Psophia* of Linnæus, are of still smaller size, and recall the water hens and the sultans in their rounded form, but are of more graceful shape and have slenderer legs and neck and a more richly tinted plumage. The head is small and regularly rounded, and the bill is stout, with the upper mandible strongly arched and terminating in a hook. The body is ovoid and the tail is very short and formed of soft feathers concealed under elongated and flocculent ones that are usually of a delicate gray passing to dark russet. This light tint of the lower part of the back contrasts with the black color of the rest of the body, and which is relieved upon the breast by green, blue, violet and golden reflections. The head and neck likewise are black and of velvety aspect, and the feathers are shorter and closer than those upon the body and resemble a sort of down very soft to the touch. The shades of the plumage vary somewhat from one species to another and permit of distinguishing the green agami (*Psophia viridis*) from the dark agami (*P. obscura*), the agami with tawny wings (*P. ochroptera*) from the agami with white wings (*P. leucoptera*), and the Rio Napo agami (*P. napensis*) from the noisy agami (*P. crepitans*).



THE AGAMI OR TRUMPETER OF GUIANA.

Of all these alleged species, some of which are certainly only local varieties formed at the expense of a same type, the last named is assuredly the one most anciently known. We find it mentioned or described in a more or less accurate manner in the relations of the travelers or naturalists of the 17th and 18th centuries and of the beginning of the present one, in the works of Father Du Tartre, Barrère, Adanson, Pallas, Vosmaer and Buffon, and in the voyage to Surinam and in the interior of Guiana of Capt. J. G. Stedman, who informs us that in his time this species was called camy-camy by the Indians and agami or trumpet bird by the colonists of Guiana. This, by the way, shows us the etymology of the French name agami, which is evidently but a corruption of the Indian name camy-camy. As for the name trumpeter or trumpet bird, that alludes to the strange sounds that the bird makes, especially when it is frightened, but which only very remotely recall the sound of a trumpet. A piercing cry succeeds for about a minute a dull rumbling, which becomes feebler and feebler. It is a curious thing that after so many years have passed since the species was discovered, and after the agami has been the subject of numerous works, naturalists do not yet appear decided as to how this sound is produced. Trail and Poeppig supposed that it resulted from the vibration of the air that the bird, keeping the bill closed, causes to penetrate from the lungs into two pockets communicating with the trachea through two narrow slits, and comparable in all respects to the vocal sacks of the Caosar emen; but the recent researches of the English naturalist Beddard have not confirmed this hypothesis. It appears that the trachea of the agami possesses no lateral slit, and does not present, at least not always, the circumvolutions mentioned by Hancock.

These agamis live in a wild state in the great forests of Guiana and that part of Brazil situated to the north of the Amazons.

They make their nest on the ground, or, more accurately speaking, they content themselves with scratching the earth with their claws at the foot of a tree, thus making an excavation which they line with grass and in which they lay a dozen eggs of a light green color. The young are very robust, and, scarcely freed from their shell, begin to trot along behind their parents. They feed at first upon insects and worms, but soon add fruits and seeds to this animal food. They remain covered for quite a long time with a soft dense down formed of fine feathers resembling hairs and very different from the feathers of the adult.

In their gait the agamis much resemble the cranes. Like the latter, they have sudden fits of gayety, during which they execute dances that contrast singularly with their ordinary gravity. When pressed by danger they are capable of running swiftly, but their flight is so heavy and so slightly sustained that they cannot, by wing, cross a river of any great width. After the young are fully grown, they continue to live in families for several months, and, like many other waders, usually unite with other bands of the same species in order to constitute flocks that often include forty individuals, and that sometimes, even, if Schomburgk is to be believed, comprise as many as 2,000 heads.

The agamis have, for more than a century, been very actively hunted for in Guiana, not on account of the quality of their flesh, which is always hard and dry, but for the value of their plumage, the brilliantly colored and chatoyant parts of which are used for making ornaments. Such hunting is so much the more profitable in that the agamis are unable to fly to a great distance, and, moreover, are easily attracted up to the gun when one succeeds in imitating their cry. When captured alive they readily get used to captivity and are easily tamed.

They are found entirely free, says Schomburgk, in all the Indian establishments. They serve as guardians to other birds. In the last century Mr. De la Borde wrote to Buffon that agamis were to be seen wandering about the streets of Cayenne, leaving the city and coming back home at night. They may be approached and handled as much as one wishes, said he, and they fear neither dogs nor birds of prey. In the poultry yard they render themselves masters of the fowls and make the latter fear them.

Almost all these birds have the habit of following some one in the street or out of the city, even persons whom they have never seen. It is in vain for one to hide or to enter a house. They will wait for him and always return to him, sometimes for more than three hours. I have sometimes began to run, added Mr. De la Borde, but they ran faster than I and always got ahead of me. When I stopped they stopped also, and very near me. I know of one that never fails to follow every stranger who enters the house of its master and to follow him around the garden until he leaves.

Mr. De Manoncourt, another correspondent of Buffon, Pistorius, Vosmaer, Stedman, Schomburgk and many other authors, ancient and modern, that we might mention, agree in recognizing the intelligence and docility of the agamis reared in captivity. These qualities, moreover, have been observed even in individuals brought to Europe at various times during the last century and preserved for several years in the zoological gardens of France, England and Holland. These birds become attached to those who take care of them, obey their voice, follow them docilely or precede them in frisking like dogs, and manifest their joy at seeing them again after an absence of some little time. They like to be caressed, and show themselves jealous of those who share the good graces of their master. When an agami has been allowed to put foot in a house it tries to drive away the cats and dogs that give it umbrage, approaches the table at meal time without invitation and does not fail to strike the black servants with its bill.

In the poultry yard these birds soon exercise their domination over the fowl therein, and it appears, even, that it has been possible at times to make them play the part of shepherds' dogs and to charge them with guarding flocks of sheep.

Even though the exactitude of these facts were not attested by authors worthy of credence, we should be

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disposed to concede that the agamis are susceptible of a certain education, for we know that a few years ago, at the Garden of Plants, a Numidian crane, that is to say a bird belonging to a family very closely allied to the agamis, conceived a very strong affection for its keeper and obeyed him like a dog. One day, even, when the keeper had taken sick, the bird, uneasy at not seeing him, went to his house, to which it knew the way on account of having gone thither several times in his company.—*La Nature.*

Arrowroot Manufacture in Queensland.

The manufacture of arrowroot is carried on extensively in the south of Queensland. In the districts of Coomera and Pimpana there are from 250 to 300 acres under cultivation, the chief plot—that known as "Rockholm"—being the property of Mr. Samuel Grimes. I recently visited this representative plantation, a description of which will serve to convey an idea of the whole.

The arrowroot grown in this district is the purple variety—the *Canna edulis.* It sometimes grows to a height of 8 feet, bears a pretty scarlet flower, and a dark purple seed pod follows, which is generally sterile. The best variety of arrowroot, the *Maranta arundinacia,* which is grown so extensively in the Bermudas, thrives well in this district, but its cultivation has been almost abandoned, owing to the difficulty of manufacture. This kind attains a height of 2 feet, and bears at maturity a small white flower somewhat resembling potato blossom. The mode of cultivation is as follows:

The ground is plowed in ridges of about 46 feet wide, and thoroughly harrowed and scarified. Nine rows are placed in this, 5 feet apart, leaving six for the row in which the by-furrow comes. Shallow furrows, 5 inches deep, are run with the plow, after which the smaller bulbs—about the size of a small apple, which are found growing at the bottom of the stems—are placed 4 feet 6 inches apart in the drill, and covered by turning a furrow from each side on to the top of the bulbs. Cultivation is then carried on by keeping it clear of weeds by means of horse hoes or "scuffiers." When it reaches the height of about 3 feet the space between the rows is turned up with a one-horse plow, the soil thrown toward the plant, and a furrow left in the middle. No further attention is required till the arrowroot is dug up for the mill. When the tubers have come to maturity, which is generally in ten months or a year's time, the crop is ready. The stalks of the plant are then cut off as close as possible to the tubers with a cane knife or strong reaping hook. The tubers are afterward raised with a grubbing hoe or mattock. They are placed with all speed in carts and conveyed to the mill, for the color is seriously affected by being exposed to the sun or weather before grinding. Sometimes as much as 50 pounds weight of tubers is obtained from the plant.

The machinery consisted in this case of a 6 horse power engine made by Messrs. Manlove, Alliott & Co., Nottingham, a root washer, grinding mill, cylinder, sieves for separating the farina from the fiber and pulp, and a centrifugal drying machine. The roots are washed in a trough 10 feet long, 3 feet deep, and 2 feet in diameter. This has a half-circular bottom, through which a stream of water is constantly running. A spindle having pegs about 4 inches apart, and of a sufficient length to reach within an inch of the bottom and sides, revolves in the trough. The pegs cleanse the bulbs of all dirt, and the latter gradually work down to one end of the trough. A wooden rake pushes the bulbs out upon a belt elevator, whence they are conveyed to the hopper of the mill. This is a wooden drum, 2 feet 6 inches wide and 2 feet in diameter. It is covered with a galvanized iron sheet punched and placed with the "burr" on the outside. The drum revolves at a high speed, and a stream of water falls upon it from tanks fixed above.

Thus the bulbs are grated up, the bulbs and the water passing through the sieve No. 1, which is a cylinder 8 feet long, with the bottom half perforated with holes about the size of a No. 7 wire nail. Within this a beater revolves, forcing the water and farina through the holes, and being placed on the screw the pulp and fiber are forced out at the end. The farina and water pass into sieve No. 2, which is similar to No. 1, except that the holes are about the size of a large pin-head in the bottom of the copper. After this it runs along a trough, where the farina is deposited and the water passes off. The farina is now dug out, and passed through sundry more sieves, and washings by hand and in tubs, then finally left to subside. When fairly firm it is taken out and passed through a centrifugal machine. It is now placed on the drying frames, about 6 feet long, with marsupial netting and calico stretched upon them. They are placed away from any dust or smoke, and the wind passing underneath, as well as the sun above, aids the drying process. But the sun and air are not alone depended upon for drying, Mr. Grimes having erected a drying house capable of accommodating 180 frames. This is heated by means of steam pipes to 140° Fah.—*Industries.*

United States and Europe in 1893.

The United States is not in the least dangerous to us in connection with military affairs. But from an economic point of view it constitutes an immediate and pressing menace. The debt contracted by the United States during the war of the secession will be completely extinguished before the end of the century, whereas the total debt of European countries is estimated at the enormous sum of 126,000,000,000 francs. The United States has an army of only 27,000 men, that is, scarcely as many as we have in one of our nineteen corps. In comparison with these 27,000 men, place the 3,500,000 soldiers kept by the European countries in time of peace, and it is easy to see how much of their productive force the European powers annually sacrifice.

It must be taken into consideration that the men thus taken from the peaceful employments are all in the height of their activity and at an age when the character is forming. The loss of revenue which results from such a state of affairs is frightful when it is looked upon as a factor in the industrial war with the United States. One must be blind not to see, in these conditions of rapid and progressive development of the United States, that Europe is threatened with such a competition that there will come a time when the balance of industrial power and political influence must be placed to the profit of the New World. That movement threatens France more than any other European nation, because France carries the heaviest load and has the largest debt. Everywhere in Europe, even among the smallest states, nothing is spoken of at present but armies, the increase of war materials, and, of course, new taxes.—*Figaro.*

Sawdust Building Bricks.

The sawdust is dried and screened, to remove the coarser particles, and is then mixed with cement, lime, and sand in the following proportions: One part cement, two parts lime, five parts sharp sand, and two parts sawdust. The sawdust is first mixed dry with the cement and sand. The final mixture is pressed into blocks, which are said to be cheap and useful. There is as much lime and more than twice as much sand as sawdust in them.

RECENTLY PATENTED INVENTIONS.

Engineering.

BALANCED SLIDE VALVE.—Daniel Kiley, Brooklyn, N. Y. This is an improvement on a formerly patented invention of the same inventor, relating to slide valves having their top surfaces protected from direct contact with the live steam that enters the steam chest from the boiler, and provides a simple relief valve attachment for the valve, to cause it to operate more reliably and prevent accident.

DREDGING APPARATUS.—James B. Quinn, New Orleans, La. A swinging frame hinged to a support carries an excavating wheel having buckets and discharging cells, the wheel being connected with a driving drum and cable, the latter being controlled by an adjustable tension device, while there are mechanisms for raising and lowering the frame to give the wheel any desired angle to the support. There are no joints or bearings subject to abrasion by the grit stirred up by dredging, the buckets are built to be very durable and automatically discharge their loads at the right time, and the apparatus is designed to be operated with comparatively little power for the work it can do.

FLOATING SUPPORT FOR DRILLING DEVICES.—Adoniram Fairchild, New York City, deceased (Benjamin D. Fairchild, administrator). Upon a hollow float is a truss frame supporting a second float, there being a derrick frame on the upper float, which supports ballast weights, while there are flexible connections between the weights and floats, and devices on the top float drawing on these connections. The invention affords a simple and practical means to neutralize the lifting force of wave action on a floating support for the drilling apparatus used to perforate the rock bottom of a harbor or other body of water.

Railway Appliances.

SWITCH OPERATING DEVICE.—Benjamin Bartelmes, Brooklyn, N. Y. This is an improvement especially adapted for use on cars of cable railways with intersecting lines on which cars are drawn by horses, the latter being switched onto and off the cable road, and liable to leave open switches from the cable road to the divergent side track. The switch adjuster consists of a vibratable presser bar carrying on its outer end a rotable presser wheel, operated by an upright shaft on the platform, by means of which the gripman of a cable car will be able to close an open switch in advance of the car.

STREET RAILWAY SWITCH.—Daniel F. Doody, Brooklyn, N. Y. This is an improvement in that class of switches adapted to be thrown by means of an actuating bar or like attachment on the car. Combined with two sleeves mounted to partially rotate and fitted one within the other, and located in a box-like structure beneath the track near the switch, is a switch lever connected with the inner one of the sleeves and with the switch point, arms adapted to be tripped by the trip arm carried on the car being made in separable sections and extending radially from the outer one of the sleeves.

Agricultural.

CULTIVATOR.—Henry Eastman, Racine, Wis. This is an implement adapted for use in working listed corn, and is supplied with runners to protect the corn, shovels to tear down the ridges, and cutters to remove weeds from the rows and direct the loosened earth toward the runners and the rows of plants. The runners may be readily adjusted to and from each other, and the shovels arranged either laterally or vertically, while adjacent to the shovels are balance rollers adapted to travel upon the ridge acted upon by the shovels, these rollers serving as guides to the machine and to preserve its equilibrium.

Miscellaneous.

BOAT STOPPING DEVICE.—Pedro Samohod, Lima, Peru. On the bow of the vessel is a post carrying a vertically sliding frame having on its sides pivoted wings adapted to extend transversely to present a large resistance surface to the water, as the frame is immersed, its normal position being raised, with the wings closed forwardly. The frame is raised and lowered by means of chains connected with a winch, and is let down when the vessel is moving into a dangerous place, or is liable to collide with another vessel or iceberg, etc.

STONE PLANER.—Charles Biganess, Quincy, Mass. This is an improvement in that class of stone-dressing machines having cutters which reciprocate and revolve simultaneously. The reciprocating and revolving shaft carrying the cutting plates has on its end rounded heads fitted by sockets in oscillating levers connected with an eccentric to oscillate the levers simultaneously. The planer shaft is revolved at a high speed, and a worm and gear mechanism makes the reciprocating movement very slow, whereby the cutting plates will be brought in contact with the entire surface of the stone, to plane it perfectly.

PRESSURE REGULATING VALVE.—August Heithecker, Brooklyn, N. Y. This valve is especially designed for reducing and regulating the pressure of gas or other fluids. Its casing is made up in two separable parts held together by screws, the construction is very simple, and there is nothing about it liable to get out of repair. The tension of the valve-closing diaphragm is regulated by a spring and screw arranged to be very nicely adjusted.

LIFE PRESERVER.—Michael O'Hara, Pittsburg, Pa. The body of this device has upper and lower series of vertical metallic tubes and intermediate horizontal semicircular tubes, with fastenings, and boxes on the breast portion, the whole adapted to be made in the form of a garment, and be light and comfortable to the wearer, while affording receptacles for food and drink.

BURGLAR AND FIRE ALARM.—William C. Dillman, Brooklyn, N. Y., and George A. Seib, New York City. This is a positive working apparatus which operates as an ordinary messenger call, and may be operated by the opening of a window or door to ring an alarm at the central station. It has automatic mechanism for shifting the device from a burglar alarm to a messenger call after the burglar alarm has been operated, and it may also be connected with any thermostatic or thermometric circuit breakers or closers to ring in an alarm in case of fire. The apparatus may be manually operated when desired without interfering with its electric mechanism.

TROUSERS HANGER.—Joseph A. Jourdan, Paris, France. This device has two integral main sections, each bent from a wire rod into two spring limbs that normally diverge, there being clasping devices on the ends of the limbs and a connecting sleeve having opposite flanges bearing on hanger loops on the main sections. A hanger hook engages the bowed ends of the loops, and sliding rings on the main limbs are adapted to press the fingers together. The device holds the garments stretched to permit its suspension in an unwrinkled condition in a wardrobe or show room.

PARALLEL RULER.—Alexis F. Gillet, Kearney, Neb. This instrument has a base support or rule along which is movable an angle holder having a transversely movable clamp section by which to secure the angle, and a step-by-step feeding mechanism for advancing the holder along the rule. The improvement is designed to enable an amateur to space section and similar lines with as great accuracy as a skilled draughtsman, while it will be useful to the latter in facilitating the rapid drawing of the lines, as the spacing may be accomplished automatically.

WAGON AXLE.—The same inventor has also obtained another patent for an axle to be used on farm implements and wheeled vehicles generally. A spindle sleeve is provided for squared or other non-circular axles, the sleeve having its inner end slitted and having at such end a tapered threaded portion on which is turned a tapered nut. The sleeve, which may be made of any suitable metal or composition, is designed to receive all the wear of the wheel, and it may be cheaply replaced when worn.

SPONGE MOISTENER.—James S. McClung, Pueblo, Col. This is a device especially adapted for use in a school room, enabling one person to properly moisten a number of sponges in a convenient and expeditious manner without bringing the hands in contact with the water or with the sponges. The device has a partitioned compartment in which is held a table and a pivoted presser plate, and may be readily carried from desk to desk by a child, to moisten and return the sponges used at each desk, the sponges being handled with pliers.

CHALK RAIL FOR BLACKBOARDS.—Willard S. Terry, Hilo, Hawaii. This rail is made in the form of a hopper-shaped receptacle having in its bottom an opening connected with an exit tube, the top of the receptacle having an apertured covering. The device supports crayons or chalk, but useless particles and dust pass to the receptacle below and are thus prevented from settling on articles in the room or being inhaled by persons in the room.

FRAME.—Heinrich Schuessler, College Point, N. Y. A simple and durable frame to hold and lock a picture, looking glass, cards or other articles, is provided by this invention. An open casing held on the back of the frame is adapted to receive the article, and a spring plate fitting in the casing presses the article on its entire back surface, a locking device fastening the plate to the casing, and effectively preventing shifting or displacement.

GUITAR.—John F. Stratton, Brooklyn, N. Y. The performer may, with this improvement, quickly change the stringing of the instrument by using either gut or metallic strings, at the same time increasing the volume and purity of the tone when metallic strings are used. An auxiliary bar or lever is secured to the bridge and engages the strings at the top in the rear of the bridge fret. By using a tail piece in connection with the bar, the strain on the resonating top of the instrument is transferred to the side, so that the top is not liable to warp.

CLASP.—Joseph F. Chatellier, New York City. This is a device for conveniently suspending hose and other wearing apparel and other articles. It has a fixed and a hinged swinging member, and the clasp is opened by moving a button out of a slot, to permit of swinging the hinged member away from the fixed member. The device is very simple, and will conveniently engage or disengage articles without tearing or injuring them.

FRUIT PITTER.—James L. Hall, Kingston, Mass., and Frank H. Chase, Grand Rivers, Ky. This is a device for conveniently removing the stones or seeds from small fruits, especially raisins. It has a wooden handle from which extend a series of elastic prongs or fingers having enlarged heads, and preferably made of round or flat steel wires or rods, a thin perforated plate or seed discharger sliding on the fingers. The fingers are forced through the skin and pulp, and are thus designed to engage the seeds, which are removed from the implement by the sliding perforated plate.

COVER FOR POTS, PANS, ETC.—David D. Davies, Wilkesbarre, Pa. This cover has a central steam escape opening, with an adjustable valve or cap to vary the size of the opening or close it altogether, a spring automatically holding the valve in adjusted position. Applied to a frying pan, this cover enables cooking to be done without greasing the stove or stewing the food, and as a ventilating pot cover it diminishes the escape of steam and tends to prevent the boiling over of water.

WIRE STRETCHER AND HOLDER.—Adolf Westmeyer, Pacific, Mo. Upon the handle of this implement are dogs adapted to clamp the wire, while upon its shank is a pivoted, bent fulcrum block on which a hook bar is movably arranged. The device forms a simple tool for stretching fence wire and holding it taut while being made fast to a post.

RIDING SADDLE.—Ferdinand E. Du Moulin, Joliet, Ill. This invention consists of an attachment comprising a fork, a knee horn detachably and adjustably secured to the fork and provided with an arm, and a leaping horn detachably secured to the arm of the knee horn. By means of the improvement the saddle may be quickly converted for use as a lady's riding or side saddle, the knee joint and leaping horn being located either at the right or left of the tree, or it may be readily changed for use by a man. When used as a

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side saddle the seat may be lengthened or shortened to accommodate the rider.

TRACE CARRIER.—William A. Mayhall, Gloster, Miss. This invention relates to buckles such as are used to connect the back band of a farm harness with the traces. The construction is simple and durable, and the buckle is very efficient in service, securely locking the traces in place and firmly holding the back band.

RUNNING GEAR.—Axel Warenskjold and John G. Burgess, San Diego, Cal. This is an improvement upon a formerly patented invention of the same inventors, for a simple and durable gear so arranged as to permit of turning the vehicle in very short curves without binding the king bolt or other working parts. The improvement embraces a fifth wheel having two fulcrums. A fifth wheel is pivoted to one of the axles, and a second fifth wheel is connected by two pivots with the other axle, while reaches crossing each other connect the axles with each other.

TROUSERS HANGER.—Arthur C. Nash, Cambridge, Mass. This device consists of a looped cord furnished at opposite ends with hooks, and provided with a button cleat and rings for tightening the cord upon the legs of the trousers. By this means trousers may be suspended in the best position for retaining their shape, and so that they will take up but little room.

SURGICAL INSTRUMENT.—Frederick C. Thompson, East Tawas, Mich. This invention comprises a novel form of forceps, attached to the jaws or blades of which near their forward ends is a soft elastic ring for use in connection with a flexible medicine cup.

MEDICINAL COMPOSITION.—Otto L. Mulot, Long Island City, N. Y. This is a composition to be used for the blood, to increase the healthy tone and natural action of the body. It comprises an electrolyzed distillate from a mixture of oil of turpentine, juniper berries, white oil of amber, aloes, gum myrrh, gum mastic, flowers of sulphur, gum olibanum, and various other ingredients, combined and prepared in a specified manner.

DESIGN FOR BOTTLE.—Daniel O'Reardon, Jersey City, N. J. This designprovides a peculiarly shaped bottle, designed to have an antique appearance, and somewhat resembling the vessels made of skins used in Oriental countries.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

SCIENTIFIC AMERICAN BUILDING EDITION.

MAY, 1893.—(No. 91.)

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Notes & Queries

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Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
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Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(5014) W. T. asks: With a stream of water 6 inches in diameter, having a head of 10 feet, and using the best turbine wheel, what would be the available horse power? Also, what would be the best water wheel to use? A. You will have an available 5 horse power. Address James Leffel & Co., Springfield, Ohio, for a good and economical turbine.

(5015) C. H. S. asks: Is there any means by which small red ants can be exterminated from a lawn without injuring the grass? If so, I should appreciate any information thereof. Reply by Prof. C. V. Riley.—It is difficult to accomplish this result without any injury to the grass, but the use of bisulphide of carbon, which I have frequently recommended, only temporarily destroys the verdure of the grass plots immediately above the nests. It turns them yellow for a few days, but does not impair the vitality of the plant. The nests of the small red ant are very small, and it will probably suffice to pour a half teaspoonful or so of the bisulphide into the principal hole of the nest and destroy and cover up the sand-like mound. With the more extensive nests of larger ants, however, it will be desirable to pour a teaspoonful of liquid down each of the principal holes of the nests and cover them ten or fifteen minutes with a wet blanket, afterward exploding the vapor at the mouth of the holes with a torch of lighted kerosened rag at the end of a long pole.

(5016) M. A. C. asks how to grind and set razors. A. Razors that have been in use so long that the edge is rounded by strapping can be brought to a flat bevel on the edge by placing them on a perfectly flat hone or other fine grained stone, with a little thin oil, as lard oil or fine machine oil, letting the back always rest upon the stone, and with small circular motions of the hand, without pressure, grinding down the bevel until the stone marks meet on both sides in a thin feather edge.

(5017) C. W. G. asks how to make potato starch. A. Convert the potatoes into a pulp by means of a scraping knife or an instrument similar to a nutmeg grater; throw the pulp upon a fine linen cloth in a large funnel, and allow pure cold water to run through the mass slowly for several hours. By this means all the minute starch granules may be washed through the cloth; and on allowing the water to stand for some time, these will settle to the bottom, and may be removed by decanting the water and straining.

(5018) R. H. P. says: Can you give me a formula for perfumed carbolic acid? A. Carbolic acid, 4 oz.; rectified spirit, 6 oz.; oil of bergamot, 28 min.; oil of citronella, 10 min.; water, to make 1 pint. Dissolve the oils and acid in the spirit and add the water, shaking well.

(5019) G. C. G. S. says: Will you please give a table showing the contraction of castings in different metals? A. Table by Bowen & Co., brass founders, London:

	Inch.	Inches of length.
In thin brass castings	1/16	in 9
In thick " "	1/8	in 10
In zinc castings	5/128	in 12
In lead, according to purity	3/128 to 4/128	in 12
In copper, " "	3/128 to 7/32	in 12
In tin, " "	1/32 to 1/16	in 12
In silver, " "	1/8	in 12
In cast iron, according to purity, small castings	1/10	in 12
In cast steel, according to purity, pipes	1/8	in 12

The above values fluctuate with the form of pattern, amount of ramming, and temperature of metal when poured. Green sand castings contract less than loam or dry sand castings.

(5020) R. W. C. says: Will you please tell how to preserve the natural colors of plants? A. A recent improved receipt for preserving plants with their natural colors is to dissolve 1 pt. salicylic acid in 600 parts of alcohol (parts by weight), heat the solution up to boiling point in an evaporating vessel and draw the plants slowly through it. Shake them to get rid of any superfluous moisture and then dry between sheets of blotting paper under pressure in the ordinary manner. Too prolonged immersion discolors violet colored flowers, and in all cases the blotting paper must be frequently renewed. The novelty appears to be the salicylic acid.—*Art Amateur.*

(5021) A. R. C. asks how to test air for sewer gas. A. Saturate unglazed paper with a solution of 1 ounce of pure lead acetate in half a pint of rain water; let it partially dry, then expose in the room suspected of containing sewer gas. The presence of the latter in any considerable quantity soon darkens or blackens the test paper.

(5022) B. J. M. wants to know how carton pierre ornaments are made. A. The following is a formula for such a composition: Glue, previously dissolved in water, 13 parts; pulverized litharge, 4 parts; white lead, 8 parts; plaster of Paris, 1 part; very fine sawdust, 10 parts. Oil the moulds to prevent adhesion.

(5023) G. F. F. asks for a remedy for buffalo moths. A. Take strips of red or blue flannel (as these colors are particularly attractive to them), dip in solution of arsenic and lay around the edges of carpets, or wherever the pests are troublesome. Said by those who have tried it to be sure death to the insects.

(5024) E. A. J. asks for the United States government formula for whitewash. A. The following coating for rough brick walls is said to be used by the United States government for painting lighthouses, and it effectually prevents moisture from striking through: Take of fresh Rosendale cement, 3 parts, and of clean, fine sand, 1 part; mix with fresh water thoroughly. This gives a gray or granite color, dark or light, according to the color of the cement. If brick color is desired, add enough Venetian red to the mixture to produce the color. If a very light color is desired, lime may be used with the cement and sand. Care must be taken to have all the ingedients well mixed together. In applying the wash, the wall must be wet with clean, fresh water; then follow immediately with the cement wash. This prevents the bricks from absorbing the water from the wash too rapidly, and gives time for the cement to set. The wash must be well stirred during the application. The mixture is to be made as thick as can be applied conveniently with a whitewash brush. It is admirably suited for brickwork, fences, etc., but it cannot be used to advantage over paint or whitewash.

(5025) N. K. K. asks: Is the incandescent lamp used as a "Geissler tube," useless without first admitting air into it (as the description given by E. M. La Briteaux)? A. The vacuum is too high to permit of using a lamp as a Geissler tube. The vacuum of an incandescent lamp is more like that of Crooke's tubes.

(5026) G. R. C. asks: In what ratio does the amount of steam (expressed by weight of water) generated under different pressures by a fixed unit of carbon vary? A. The total heat from 32° of one pound of steam at 0 pressure is 1,146 heat units and at 100 pounds pressure is 1,184 heat units. One pound of best coal, with perfect combustion, gives out from 14,000 to 15,000 heat units, and will make from 11 to 12½ pounds of steam at 100 pounds pressure if no heat is lost.

(5027) D. W. says: 1. I want to build the simple electric motor described in "Experimental Science." It does not state whether the magnet wire used is single or double wound. Which is it? A. You can use either a single or double covered wire. There is less danger of crosses when double-covered wire is used. 2. Will the same size machine, with cast fields and wound as described for dynamo, furnish current sufficient for the motor to run two or three sewing machines? A. When the machine is used as a dynamo in the manner suggested it will not furnish current enough for running two sewing machines.

(5028) H. A. F. asks: Will you kindly give me advice on the following: I have a 16 foot boat, galvanized iron No. 18, in compartments of 3 feet, without any ribs, but well braced. As I intend to put a 1 horse power gasoline motor in it, will I need to put in any ribs, and, if so, will 1/8 + 1 angle iron do? And will I need any papers of pilot or engineer to run the same? A. You should strengthen the shell of your boat near the engine. The 1 inch angle iron ribs will do. You will need a pilot's license if you run on waters having commercial traffic.

(5029) J. H. W.—The sawmill dogs you describe are, no doubt, steel castings, which are made by melting and pouring cast steel, and can be forged and tempered like bar steel. Steel castings are far better than malleable iron castings.

(5030) A. C. asks: Are not malleable iron tube fittings preferable to cast iron ones for steam and hot water heating purposes, and also for piping steam under ordinary pressures, provided the interior shape is the same? A. The malleable fittings are preferable when made with taper threads for steam use, wherever there is liability of accidental breakage of the fittings and danger from leakage. For ordinary steam piping, cast iron fittings are in almost universal use and considered safe.

(5031) B. W. C. asks: Is the sun motor used in this country? Could you pump water 160 feet, and cost? A. The sun motor, so far, has been only an experiment. With the ordinary force pump, water may be easily raised the height you mention.

(5032) S. H. B. asks: Is there any appliance by which sorghum juice can be evaporated by running steam pipe through the juice and applying the heat in that way? I have a friend who is raising sorghum, and he thinks there should be some way of evaporating by steam heat through pipes. He wants to make sirup or molasses, not sugar. An answer to this will be appreciated. A. Sorghum juice can be evaporated in large flat pans with a flat coil of steam pipe in the bottom of the pan.

(5033) J. B. asks: Is hemlock suitable for studs and joists in building a frame house? If not, what are the objections to it? A. Hemlock for studding and joist is liable to warp and spring out of line and is more shaky than pine; yet it is largely used now in cottage houses, on account of cheapness.

(5034) G. C. B. asks: 1. How high are the highest masts of sailing vessels, and how much canvas do they spread? A. The tallest masts are from 160 to 180 feet high, and spread from 60,000 to 100,000 square feet of canvas. 2. What is the curvature of the earth in inches per mile? A. The curvature of the earth is 8 inches per mile.

(5035) G. W. B. asks: Will a boiler built to furnish steam at 100 pounds pressure for an 18 inch cylinder, 18 inch stroke, furnish steam for a steeple compound engine, 18 inch high pressure and 36 inch low pressure cylinders, 18 inch stroke, both having condensers? If not, why? A. For equal indicated horse powers the compound condensing engine uses, or should use, less steam than any single cylinder condensing engine. With the arrangement as stated, with both high pressure cylinders alike, the compound engine, with proper cut-off, may be twice the power of the single cylinder engine, and may, by the relation of cut-off on each engine, require more steam.

(5036) W. F. C. writes: Is there any high explosive, not easily fired by concussion, that could be safely used in bombs for ordinary cannons or mortars? What is supposed to be the original substance of volcanic ashes? Are these ashes considered evidence that the internal heat of the earth is produced by combustion? By analogy the heat of the sun is due to the same cause. Is this the reason why scientists claim that it will eventually expire? A. There is no high explosive as yet known that will stand the initial concussion of discharge from guns. Much experiment has been made in this direction, but without as yet practical results. Volcanic ashes are of much the same composition as pumice stone, or nearly the same as the primary rock formation of the earth—principally silica and feldspar, with a small admixture of metallic oxides. There is no evidence from volcanic eruption, or the material thrown out, that there is combustion going on within the earth. The heat held in the interior of the globe is assumed to have been nascent with its creation, and the interior heated mass to be inert, volcanic activity being the vent for the relief of the pressure upon the hot fluid mass of the interior, caused by the contraction of the earth's crust by loss of heat from radiation. The heat of the sun is reasonably assumed to have been derived in the same manner, only that its immense mass has made it slow to cool. The condensing theory of the progress of creation indicates that the sun and the solar system is a cycle in the events of eternal time. Its life existence had a beginning and will have an end.

(5037) J. W. writes: What is the most practicable way of storing power for future use, if any? I am owner of water power with limited storage for water and am obliged to operate wheels most of the time, in fact all the time, and could use in 18 hours all the power I could develop in the 24 with the amount of water available; how could I store the 6 hours power that goes to waste? I operate electric power and light plant 18 hours out of 24. A. In the absence of particulars as to the limit of water storage, the question of a higher dam, which alone will increase the power in the proportion that the additional height bears to the present height, or the addition of power by the storage of water, need not be discussed, as you say you have a limited storage. There is but one other way that may be made available directly in your line of operation, and that is electrical storage. With your present plant you may charge storage batteries during the 6 hours to the full extent and power of your electric plant, and also utilize any excess of power that you may have to spare from the present operation for power and light.

(5038) Enquirer, Va., writes: Please advise me of an approved plan of ventilating under a building where the joists are near the ground. In this flat country if we excavate more than 12 to 18 inches, water stands under the floor and the floor joists decay, first in the brick walls and then throughout. A. Buildings on wet ground should have at least 3 feet space between the ground and the joists, and if stone or brick foundations are used, holes 1 foot square should be made through the foundation close to the sills on each side near the corners and along the sides, and covered with galvanized wire netting fine enough to keep out mice. This will give the wind

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a clear circulation under the building, and keep the ground as dry as possible under the condition of a wet soil. If a layer of concrete or sand and hydraulic cement can be spread under such a building, it will greatly help to keep the lower story dry and preserve the timber from decay.

(5039) Amateur asks: In computing horse power of steam boiler what proportion of shell is considered heating surface? A. All of the shell exposed to the fire and heated gases. 2. Does the horse power of boiler increase in same ratio as steam pressure, *i. e.*, if a boiler is 30 horse power with 60 pounds, will it be 40 horse power with 80 pounds steam? A. Yes. 3. With boiler pressure at 80 pounds, what is the pressure in cylinder of slide valve engine in motion? What makes the difference? A. The cut-off of the valve, which prevents the following of the steam to the full stroke, makes the mean pressure. 4. How can the power a slide valve engine is exerting under varying loads be found without the use of indicator? Boiler pressure at 80 pounds. A. By a dynamometer. For excellent articles on dynamometers in general see our SUPPLEMENT Nos. 264, 359, 376, 436, 684, especially the two first named ones.

(5040) J. B. D. asks: What is a good roof paint that will last five years at least, on either iron or shingle roofs, one I can prepare myself? A. The most durable paint for roofs is red oxide of iron or Prince's metallic paint (dry); mix it with raw linseed oil for shingle roofs; first coat thin, so as to spread easily with the brush. When this has well dried, which may be several days, paint with the same paint mixed with boiled linseed oil, just thick enough to spread well with a brush. For iron roofs use boiled linseed oil with the same paint for both coats.

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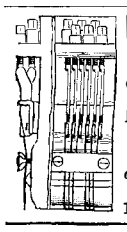

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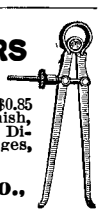

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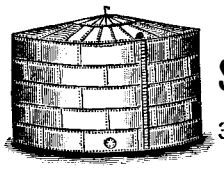

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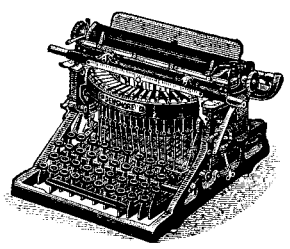

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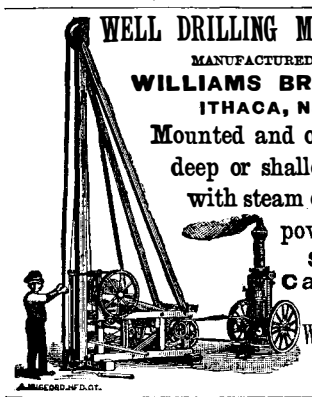

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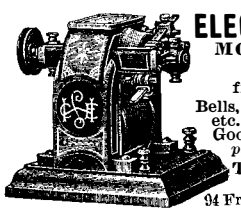

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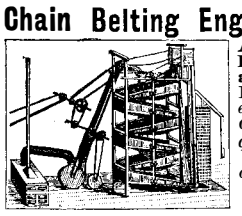

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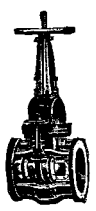

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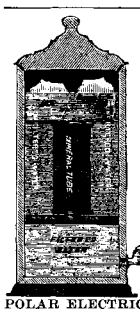

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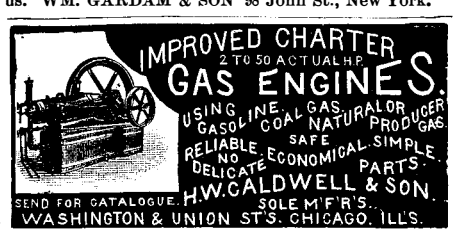

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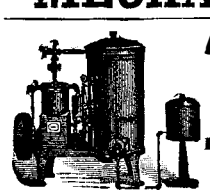

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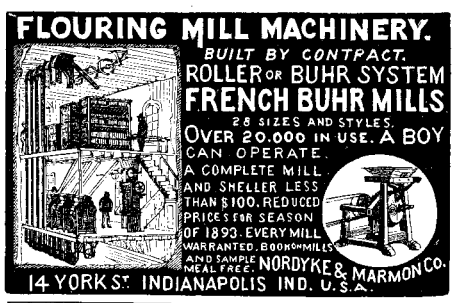
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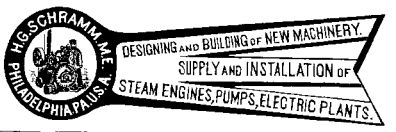
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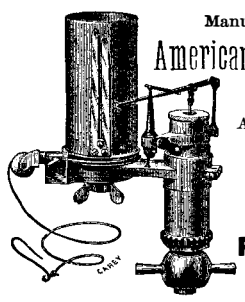

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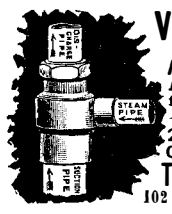

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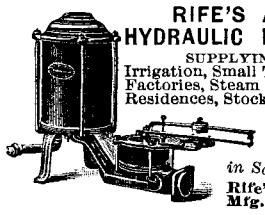

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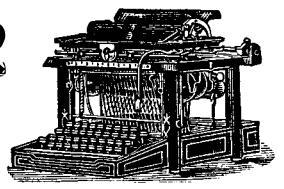

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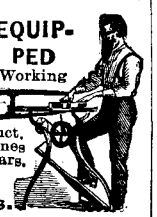

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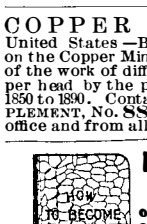

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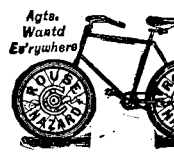

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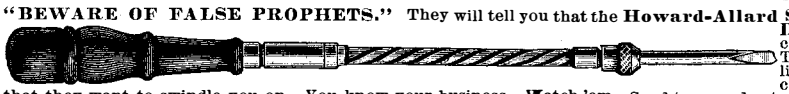

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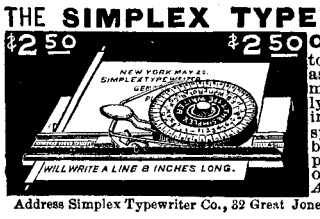

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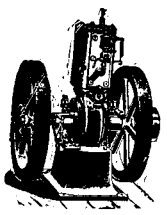

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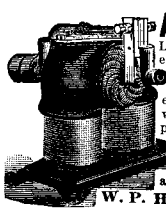

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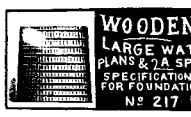
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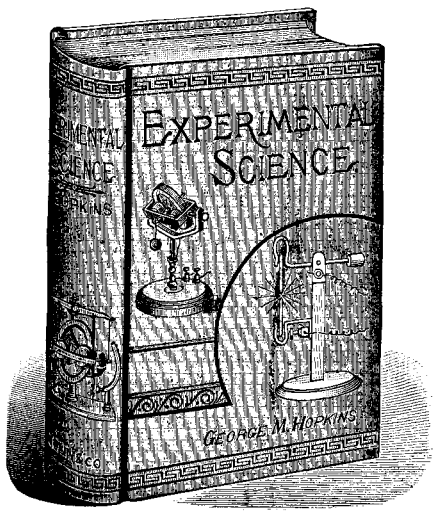

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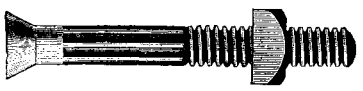

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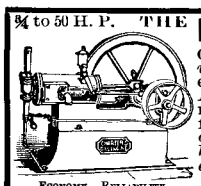

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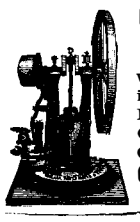

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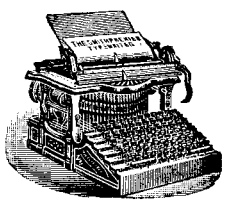

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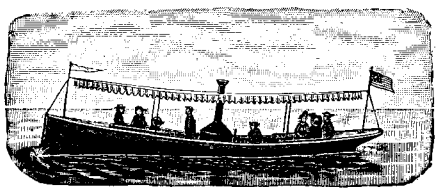

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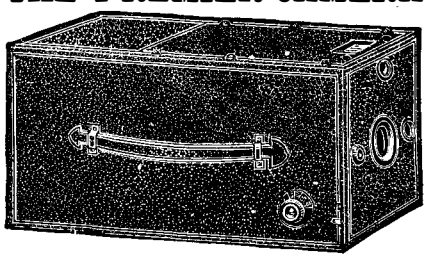

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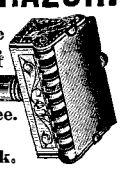

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